SCIENTIFIC AMERICAN

JULY 1928 ★ *Thirty-five Cents a Copy*

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By D. T. MacDOUGAL

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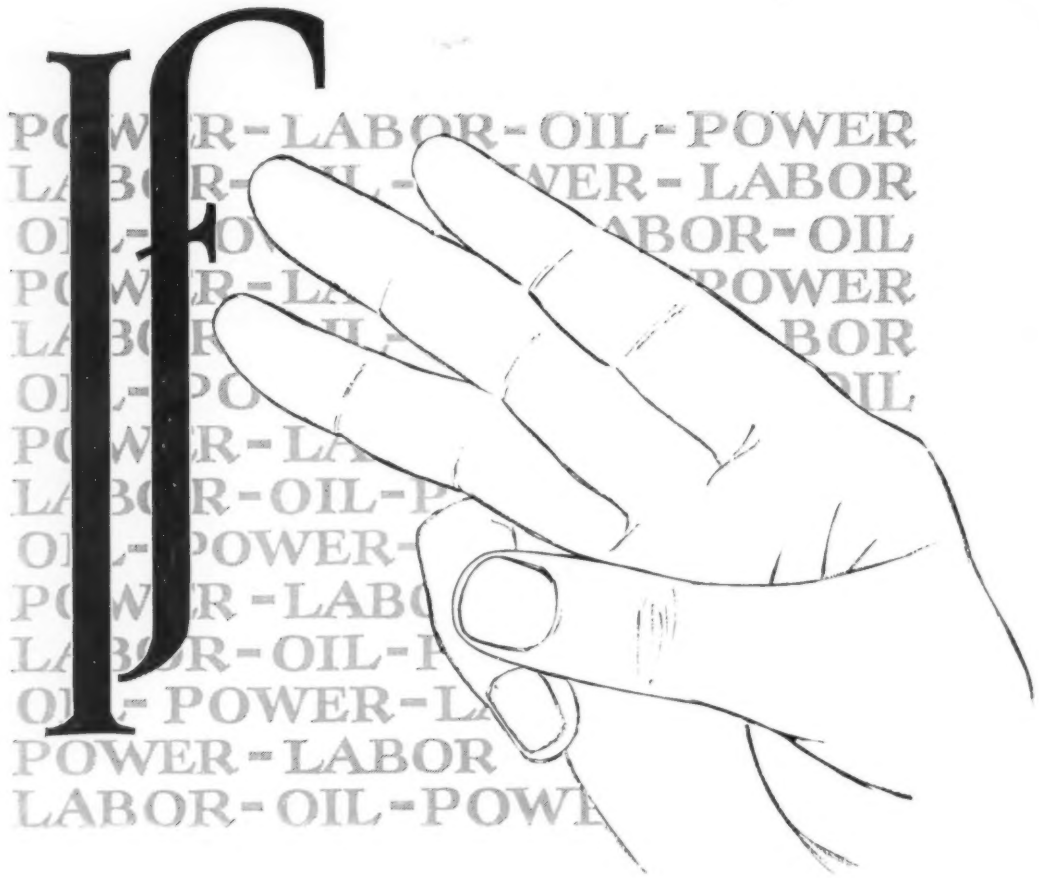

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COVER

Our artist, Howard V. Brown, has vividly portrayed a cultivated field of the rubber-producing shrub, guayule. Turn to page 16 for the story.

Creating Car Life

Timken Bearing steel is produced in Timken electric furnaces and processed in the Timken mill to become the most wear-resistant bearing material ever known.

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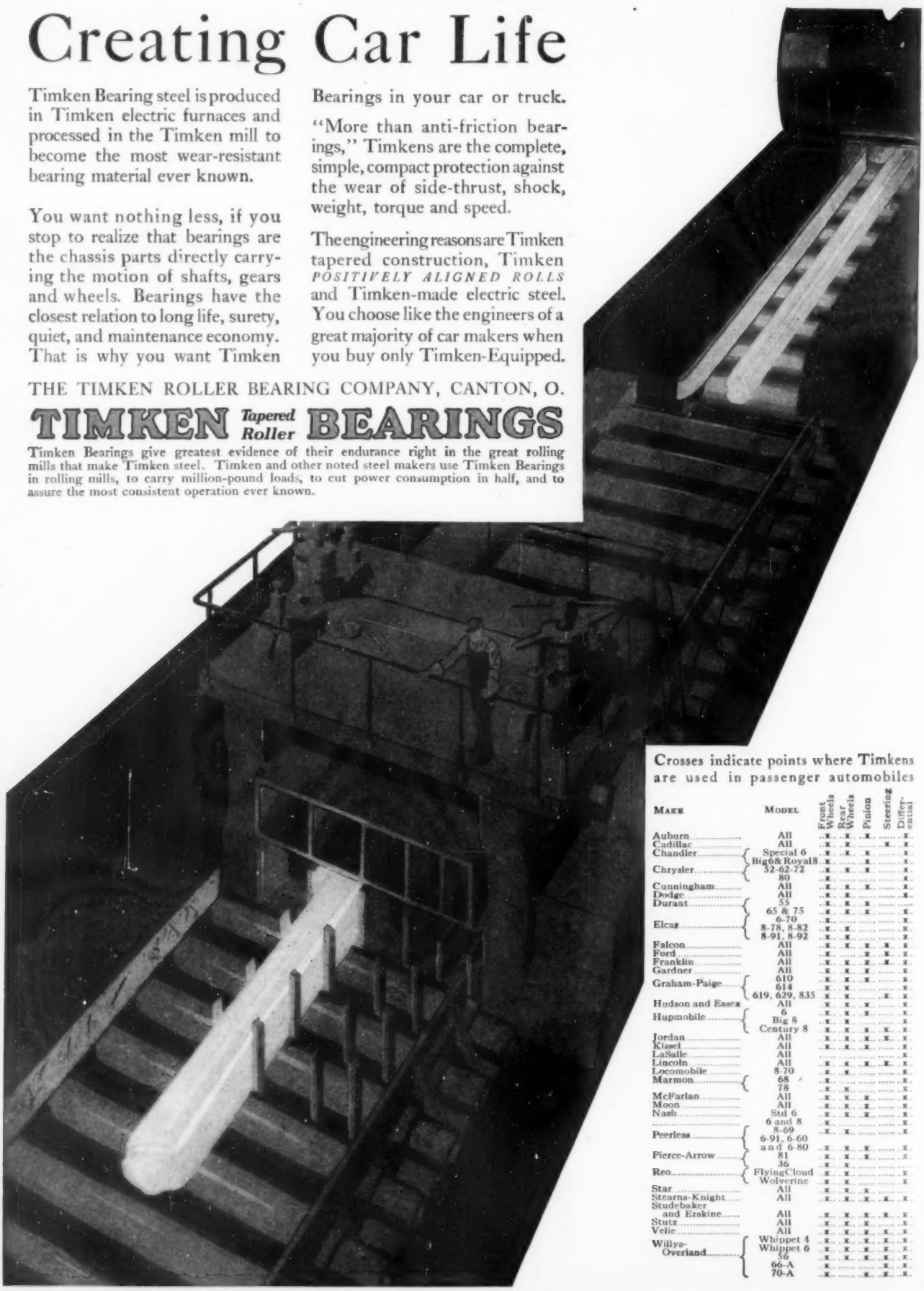

Crosses indicate points where Timkens are used in passenger automobiles

Make	Model	Front Wheels	Rear Wheels	Pinion	Steering	Differential
Auburn	All	x	x	x		x
Cadillac	All	x	x		x	x
Chandler	Special 6	x	x	x		x
	Big 6 & Royal 8	x		x		x
Chrysler	32-62-72	x	x	x		x
	80	x				x
Cunningham	All	x	x	x		x
Dodge	All	x	x			x
Durant	55	x	x	x		
	65 & 75	x	x	x		x
Elcar	6-70	x				x
	8-78, 8-82	x	x			x
	8-91, 8-92	x	x			x
Falcon	All	x	x	x	x	x
Ford	All	x		x	x	x
Franklin	All	x	x	x	x	x
Gardner	All	x	x	x		x
Graham-Paige	610	x	x	x		x
	614	x	x			x
	619, 629, 835	x	x		x	x
Hudson and Essex	All	x	x	x		x
Hupmobile	6	x	x	x		x
	Big 8	x	x			x
	Century 8	x	x	x	x	x
Jordan	All	x	x	x	x	x
Kissel	All	x	x	x		x
LaSalle	All					x
Lincoln	All	x	x	x	x	x
Locomobile	8-70	x	x			x
Marmon	68	x				x
	78	x	x			x
McFarlan	All	x	x	x		x
Moon	All	x	x	x		x
Nash	Std 6	x	x	x		x
	6 and 8	x				x
Peerless	8-69	x	x			x
	6-91, 6-60 and 6-80	x	x	x		x
Pierce-Arrow	81	x	x	x		x
	36	x	x			x
Reo	Flying Cloud	x	x			x
	Wolverine	x	x			x
Star	All	x	x	x		
Stearns-Knight	All	x	x	x	x	x
Studebaker and Erskine	All	x	x	x	x	x
Stutz	All	x	x	x	x	x
Velie	All	x	x	x	x	x
Willys-Overland	Whippet 4	x	x	x	x	x
	Whippet 6	x	x	x	x	x
	56	x	x	x	x	x
	66-A	x		x	x	x
	70-A	x		x	x	x

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Looking Ahead *With the* Editor

Aristotle Dethroned

WHEN Galileo, working for 15 cents a day as professor of mathematics at the University of Pisa, contended that heavy and light bodies fall at the same rate, the idea was hooted. Aristotle, preceptor of the age, had said otherwise. But Galileo persisted, proved his contention, and learned many other scientific truths. The outline of the progress of physics since then, to be published soon, makes a story as interesting as fiction.

A Huge Hydro-electric Development

IN an article to appear soon, a comprehensive description will be given of the new hydro-electric plant on the Susquehanna River in Maryland. Its machinery for producing 378,000 horsepower represents the largest units ever installed in a single plant at one time. Several other features, some of which are the largest in the world, make this plant well worth study by practicing engineers as well as students of engineering.

The Museum Proves This Fish Story

ZANE GREY is not an ichthyologist; he is an angler of no little fame. But the catches he and his party have made in New Zealand waters are of interest to both the angler and the scientist. Mr. Grey is, first of all, a sportsman, but many specimens subdued by him with rod and line, are now on exhibition in the American Museum of Natural History. His article about his remarkable catches is ready for release.

Taking the Next "Ship" to Mars

ANOTHER romance? Jules Verne or H. G. Wells? Neither; the article which we shall present at an early date, concerns a physicist's concept of a method for making a trip from the Earth to Mars. Laymen who read the manuscript scoffed, but several scientists pronounced this interplanetary flight practicable. The "ship" is not a projectile, but a rocket, the details of which have been worked out scientifically. Coming soon.

Chromium Plating

SO great has been the interest in the process of chromium plating of metals during recent months that we have arranged to give you an article about it. Bunsen first obtained metallic chromium 75 years ago but its introduction as a commercial plating metal is of comparatively recent date. Even now, although many common products are chromium plated—especially where extreme hardness of surface is desirable—the process is a difficult one requiring much study.

Every Issue Fully Illustrated

¶ *The well-informed man or woman is the one who progresses. Why not let the* SCIENTIFIC AMERICAN *bring to you the latest news of the scientific world in general? The cost is nominal—only four dollars for an entire year's subscription.*

Among our Contributors

D. T. MacDougal

Dr. MacDougal, one of our corresponding editors, is a plant physiologist who enjoys digging to the bottom of things. Out in the desert regions of Arizona, he puts trees through all sorts of measurements to ascertain, not merely how they grow, but why. He injects chemicals into cacti and watches the circulation of the sap. Incidentally, he keeps one eye on desert rubber, for his life work has been devoted to adapting desert plants to domestic life and adapting domestic plants to desert climates.

Paul R. Heyl

By now our readers are quite familiar with Dr. Heyl's writing. At the United States Bureau of Standards he is usually concentrated on some problem indirectly vital to the world. He has something of a reputation as a popularizer of science; few scientists so ably understand and explain difficulties that perplex the beginner.

Harold J. Cook

A university-trained geologist, Mr. Cook has two strings to his bow: he earns his living as a petroleum geologist, and makes fossil hunting his avocation. His bailiwick is the entire west. Some of the investigations of geological discoveries which he has made for the editors, give promise of "proving up" in evidence most precious to science.

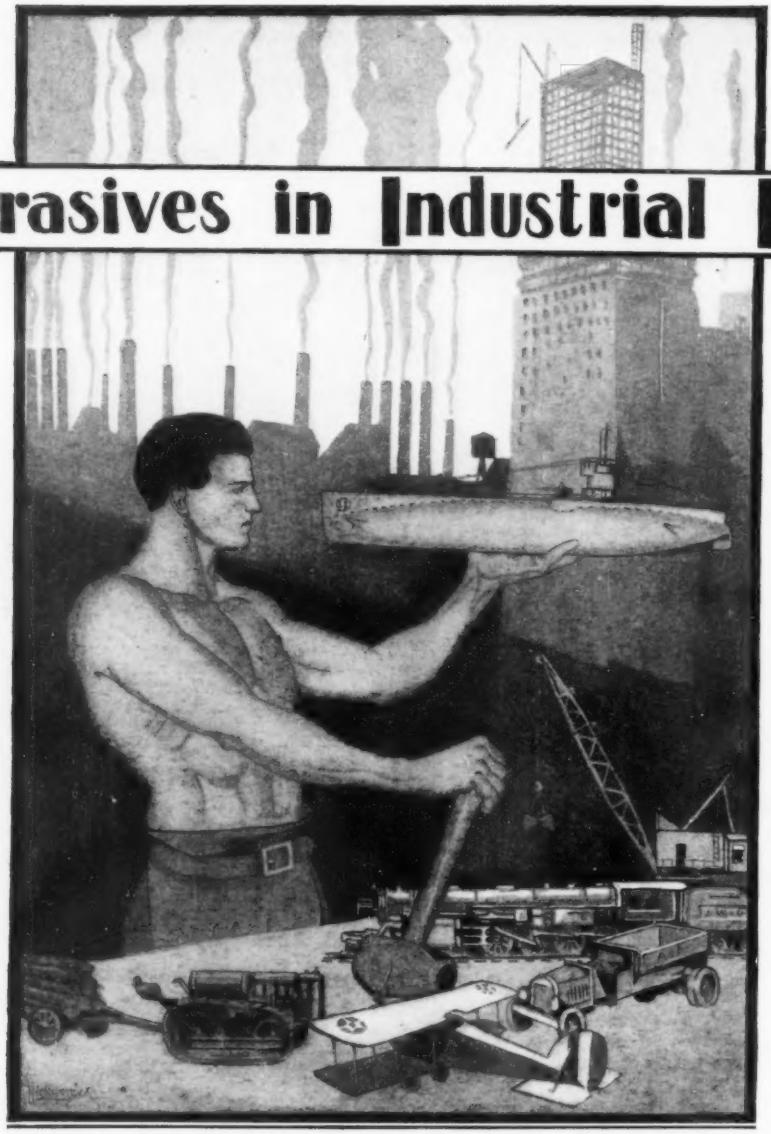
Charles P. Olivier

Professor Olivier is an authority on meteors, his book entitled "Meteors" being the last word on that subject. He heads the American Meteor Society, which you may easily join. Next September he will assume the directorship of the Flower Observatory of the University of Pennsylvania, located in the suburbs of Philadelphia.

Henry Norris Russell

Professor Russell, another of our corresponding editors, has been a contributor for 27 years, during which time he has sent us regularly a monthly article on astronomy. His astronomical researches have won for him no less than four scientific medals. He is a member of many scientific societies, Chairman of the Department of Astronomy of Princeton University, and is a Research Associate of Mount Wilson Observatory.

Abrasives in Industrial Progress



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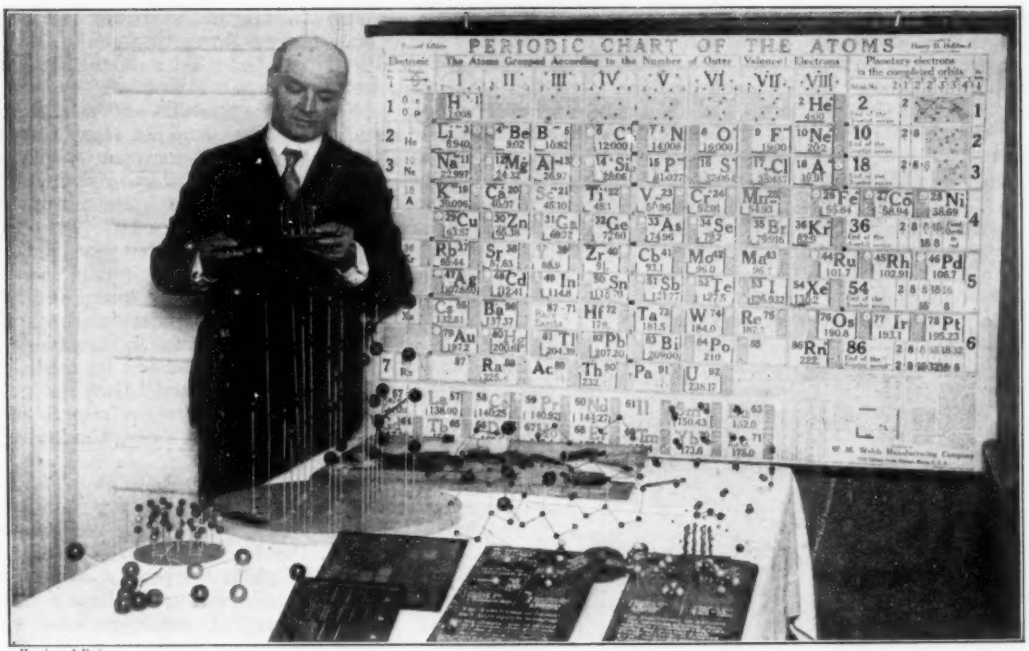
Edward W. Berry

PROFESSOR EDWARD W. BERRY of Johns Hopkins University, whose article, "How Old Are the Everlasting Hills," starts on page 31, specializes in that particular corner of the science of paleontology known as paleobotany, the study of the evolution of plant life by means of the fossil evidences of the rocks, although his university work deals mostly with the animal side of the subject. There are few paleontologists and far fewer paleobotanists —a mere handful, in fact, of these super-specialists. Professor Berry has had an unusual career, for a scientist; he began as a business man and newspaper man, having been president and manager of the *Passaic* (New Jersey) *News* during eight years. However, he had leaned toward science even as a boy, having collected, according to local tradition, nearly all the fossils in Schoharie County, New York, his home county, before he was 13 years of age. After departing from newspaper work he won his way to full professorship in paleontology at Johns Hopkins, where it is frequently said by his students that he is a great teacher because he "makes them think." Here he is shown in his laboratory.

M-G-M News

Captain George H. Wilkins

CAPTAIN WILKINS (who wears the cap; the other is his pilot, Lieutenant Eielson) literally leaped to world fame when he recently flew across the top of the world from Alaska to Spitsbergen in 21 hours. Captain Wilkins is an Australian. Back of this epochal flight is a long period of service and training in exploration, first as second-in-command under the explorer Stefanson in the arctic; then as second-in-command with the British Imperial Antarctic Expedition of 1920-21; later as naturalist with Shackleton in 1921-22; and in 1923-25 as leader of an expedition for the British Museum. His recent flight, together with evidence provided by some previous deep soundings he made in the arctic, practically destroys the force of the old Harris theory of a large arctic land mass and reinforces the Nansen theory that the arctic is a great, deep ocean basin, similar in this characteristic to those of the other great oceans of the world.



Harris and Ewing

MODELS OF MOLECULES AND ATOMS, AND THE PERIODIC TABLE

Mr. Hubbard of the Bureau of Standards holding in his right hand a model of the tetrahedral carbon atom. In front of him is the diamond molecule with its "interlocked" atoms of carbon—the real reason for the hardness of diamonds

What *Is An* Atom?*

The Newest Concept of the Atom Is Known as the "Schrödinger" Atom. What Is Its Fundamental Nature?

By PAUL R. HEYL, Ph.D.
Physicist, United States Bureau of Standards

"I WANT to see an atom!" announced the visitor.

"So do I!" replied the scientist to whose office the visitor had come.

"But can't you show me one?" pursued the visitor. "I thought the Bureau of Standards had the best of everything in the way of equipment—microscopes and all."

The scientist shook his head.

"The best is not good enough for that. No one has ever seen an atom; none of us here hopes ever to see one. It is like the famous purple cow."

"Is that the case?" asked the visitor, disappointedly.

"Yes. Their size is one reason why we cannot see them. It is a good microscope that will clearly define an object one hundred-thousandth of an inch in diameter; yet into a cube of this size one might easily pack a hundred million atoms. And even if we had a sufficiently powerful microscope the atoms would not stand still long enough for us to see what they look like."

"But then how have you found out all that you know about them?"

"We know very little about them—not nearly as much as is commonly supposed. We do know their size roughly, within certain limits, and we know pretty well how they behave under all sorts of conditions; for the behavior of atoms (and molecules) under different conditions is all that physical or chemical experiment can tell us; but as to what an atom looks like, we know nothing at all."

"BUT, pardon me," said the visitor, "does not an atom resemble a miniature solar system?"

"That was Bohr's idea of its appearance, and a most useful and valuable concept it has been."

"So the Bohr atom is a 'has been'?"

The scientist smiled.

"It never was entirely satisfactory, even to the inventor himself. It was accepted provisionally—in fact, we may say tolerated for lack of a better."

"That is strange," mused the visitor. "I never thought that the Bohr atom had any faults—that is, any serious ones. I supposed from the way it was talked and written about that it was all right—a real scientific discovery."

"The Bohr atom had many good points. It was far and away ahead of anything that had ever been devised before, but it so happened that its good points were of such a nature as to lend themselves readily to popular exposition, while its shortcomings were of a more difficult and technical character."

"But," urged the visitor, "the Bohr atom is so in harmony with that part of the structure of Nature which is large enough for us to see—just like our planetary system. Is it not likely that the architecture of Nature is one from electron to star? I can hardly believe that it is not so. It is so beautiful that it must be true!"

The scientist smiled again, perhaps a little sadly.

"If we could see the real plan of an atom, absolutely free from blemishes as it must be, it would be so true that nothing could be more beautiful."

*Publication approved by the Director of the Bureau of Standards of the U. S. Department of Commerce.

The visitor was silent for a few minutes. Then he said slowly:

"There is something I do not understand. In speaking about the Bohr atom you have used the words 'Bohr's idea,' 'inventor' and 'devised.' Was it not a discovery?"

"No, I have used the plain English for it. The story of the Bohr atom is no departure from the history of all our past ideas about atoms. We learn by experiment that an atom will do certain things. We then exercise our inventiveness and ingenuity in imagining a model of an atom that will do these things. Then we experiment further and learn some new things that an atom can do. If our model is capable of performing these tricks also, well and good; but it always happens sooner or later that our model breaks down under some task imposed upon it by new discoveries. Then we must either alter it or abandon it and devise a new one."

"Who invented the first model of the atom, and what was it?"

"THE ancients guessed that there might be such things, but they had next to no experimental results to control their guesses, and in consequence their fancy had free play. The first model of an atom that properly belongs in the modern scientific period is that of Newton. Here is what he said about it in his 'Opticks'." And the scientist took down a book from a shelf behind him.

"'It seems probable to me that God in the beginning formed matter in solid, massy, hard, impenetrable, movable particles of such sizes and figures, and with such other properties and in such proportion to space as most conduced to the end for which he formed them; and that these primitive particles being solids are incomparably harder than any porous bodies compounded of them; even so very hard as never to wear or break in pieces; no ordinary power being able to divide what God made one in the first creation.'"

"You will notice one important point," said the scientist, laying down the book. "Newton imagined the atoms as infinitely hard, and explained the softness of bodies by saying that it was due in some way to the arrangement and mutual action of their hard constituent particles. Two hundred years later Lord Kelvin completely reversed this mental attitude, and taught us to look for the explanation of the hardness of bodies in the rapid motion of something infinitely soft and yielding."

"Yes," said the visitor, whose hair was gray. "I think I remember hearing about that when I was in college. He thought an atom was something like a smoke ring, didn't he?"

"Yes, a vortex atom, he called it. He adduced several familiar facts in support of this new view point. The stream of water from the nozzle of a fire hose will turn aside the blow of an axe; and the rag wheel used in burnishing is, when at rest, as loose and floppy a structure as one can well imagine, but when set rapidly spinning it becomes so stiff that it takes considerable force to bend it. Lord Kelvin's idea was that an atom might be a spinning vortex ring in the ether which carried light waves through space."

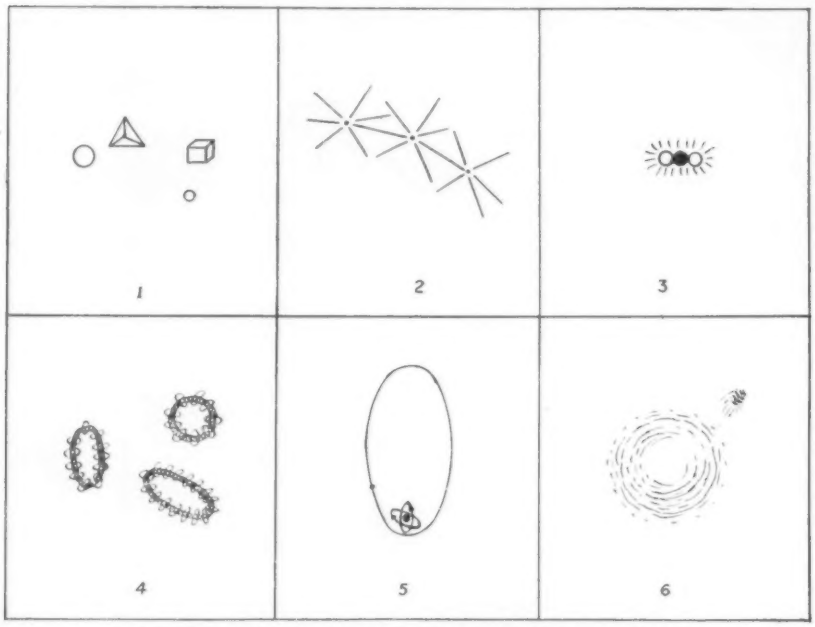
"And what happened to this model? The usual thing?"

The scientist nodded.

"The same old story that had been told so often in the two centuries between Newton and Kelvin. The vortex atom fulfilled quite a number of the requirements, which were rather numerous, even fifty years ago. It could vibrate from a circular to an elliptical shape and back again, and in so doing send out ripples in the surrounding ether—that is, light waves. But one thing it could not be made to do, nor could any model that had preceded it. They absolutely refused to attract each other. This sealed the fate of the vortex atom."

"What took its place?"

"Nothing—for a generation. In the closing years of the nineteenth century the late Professor Rowland of Johns Hopkins University, impressed by the number of lines in the spectrum of iron, said: 'I do not know what an atom of iron may be, but it must be as complicated a structure as a grand piano'."



THE EVOLUTION OF MAN'S CONCEPT OF THE ATOM

1: Newton's concept (1704)—hard particles; various shapes. 2: "Centers of force" or mathematical points of Boscovich (1758). 3: Dalton's particles having definite weights (1810). 4: Kelvin (1867) vortex ring atom. 5: Bohr's lithium atom (1913). 6: Schrödinger's atom (1925)

"THE Bohr atom is much simpler than that."

"Yes, but we must remember that Rowland did not live to see the beginning of the great development in physical science that followed the discovery of the X rays. As a result of the new knowledge this has brought us we have learned one important thing about the atom: it must be electrical in its structure."

"That is a long way from Newton's grains of flint," said the visitor.

"Yes, indeed. Since we have as yet no idea of what electricity may be, an atom built of it is rather a transcendental affair."

"This is all very interesting," said the visitor. "Almost as good as seeing an atom. I can see now why Bohr built up his model from electric charges—electrons and protons, I believe they are called. But would the Bohr atom gravitate?"

The scientist laughed.

"It didn't have to."

"Didn't have to? After the vortex atom and all the rest had gone into the discard for that very reason? What had happened in the meantime?"

"Einstein."

The visitor threw up his hands and shook his head.

"I'll take your word for it," said he. "What is it?"

"Prior to Einstein," explained the scientist, "gravitation was regarded as a property of matter. Einstein pointed out that it might be a property of space. According to this, matter gravitates not because of any peculiarity in its structure but because of the properties of the space that surrounds it. Any kind of an atom is as good as any

other from this new point of view."

"Then why not reconsider some of the earlier models?"

"No, we have discovered so much that is new about atomic behavior that the older models are hopelessly inadequate and out of the running."

"Just as the Bohr atom is, if I understand you correctly. But what is the exact trouble with it?"

"Something which was recognized from the very start, and was pointed out by Bohr himself. Simple and natural as the Bohr atom may appear, there is a serious indictment to be brought against it: it is not self-consistent. In order to make his atom work, Bohr found it necessary to play fast and loose with established electrical principles, discarding them where advisable and retaining them where convenient without any excuse other than necessity.

"FOR example, a charged particle such as an electron should radiate energy when revolving in a circle. Bohr said that it should not, but in the next breath admitted that it should radiate while changing from one orbit to another. No one was readier to admit this inconsistency than Bohr himself. His justification for it was that it worked well, and it certainly did. The success of the Bohr atom in accounting for chemical and physical facts has been almost uncanny. Upon the basis of these untenable assumptions Bohr and his fellow workers erected a statue marvelously true to Nature, yet this statue had feet of clay. We tolerated it for lack of a better, knowing that it was doomed to fall as soon as a more logical and consistent substitute should make its appearance."

"And has something else made its appearance, or are we still without any mental picture of an atom?"

"Something else has made its appearance, but I would hardly say that we can get as good a mental picture of it as we had of the Bohr atom. It is the wave atom of Schrödinger."

"I haven't heard of that," said the visitor.

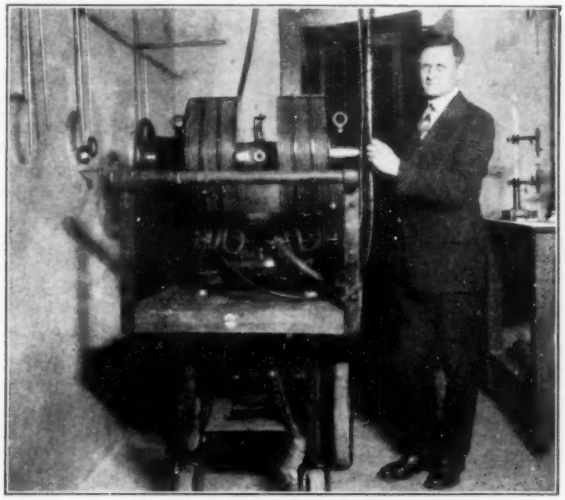
"No," said the scientist. "It is only three years old, and many of us professionals are still rather hazy in our understanding of it."

"Of course it must be electrical, from what you have said."

"Yes, certainly; that feature appears to be definitely fixed in all atomic models. The difference between the Schrödinger atom and the Bohr atom is, to begin with, one of distribution of the electricity. In the Bohr atom, as you know, there was a positive charge on the central nucleus, and negative charges on each planet or electron. The electric charge was localized in spots. But in Schrödinger's atom the charge is spread everywhere throughout the volume of a little sphere of atomic dimensions. Again, the electrons in Bohr's atom were in rapid motion in their orbits, while in the Schrödinger atom the electric charge does not move about. It does, however, change its intensity at different points in the sphere at different instants of time. This fluctuation in the strength of the electric charge sets up light waves in the surrounding space."

"THE Bohr atom, as I recollect it," said the visitor, "was in the habit of throwing off one of its electrons occasionally. I used to picture that as drops of water being thrown off from a rapidly revolving grindstone."

"Yes," said the scientist. "Every atomic model must be able to do that. Experimental evidence demands it. Schrödinger pictures it in this way: his quivering ball of electric charge throws off a small portion of itself, a little bunch of vibrating energy, which represents the electron. Perhaps later on this little bunch of energy strikes another atom somewhere else, and coalesces with it, adding its energy to the larger quivering mass. You have seen tufts of isolated flame rising from a wood fire; except for the fact that they do not last more than half a second or so, they represent pretty well Schrödinger's idea of the emission of an electron from an atom."



EVIDENCE THAT ATOMS ARE ELECTRICAL

The spectrum of an element may be altered by an intense magnetic field—the "Zeeman effect." Dr. W. F. Meggers of the Bureau of Standards, standing beside the magnets employed

"There doesn't seem to be much complicated mechanism in that," said the visitor, thoughtfully. "I wonder what Rowland would have said of it."

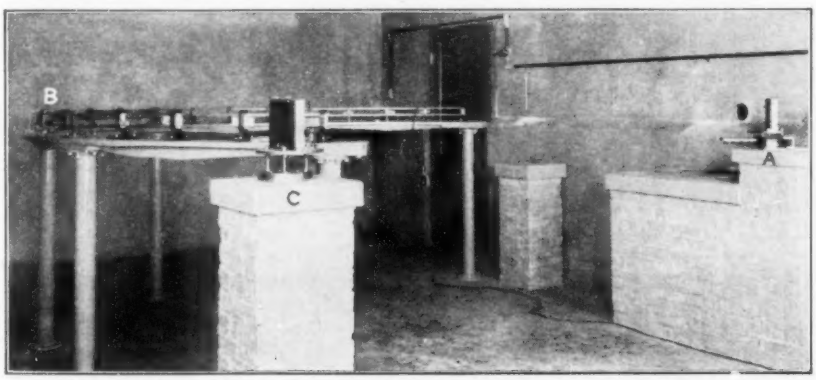
"True," said the scientist. "Our atomic models in their general aspect do seem to be getting simpler, but their mathematical theory makes up for that. To follow up the behavior to be expected of a quivering ball of electric charge such as the Schrödinger atom requires mathematical equipment of no mean order."

"SUPPOSE it done," said the visitor. "What will the Schrödinger atom do?"

"Everything that the Bohr atom could do, and a little more; and the best thing about it is that it works without doing violence to established electrical principles as did Bohr's atom."

"Yet I suppose you will eventually find something the matter with it?"

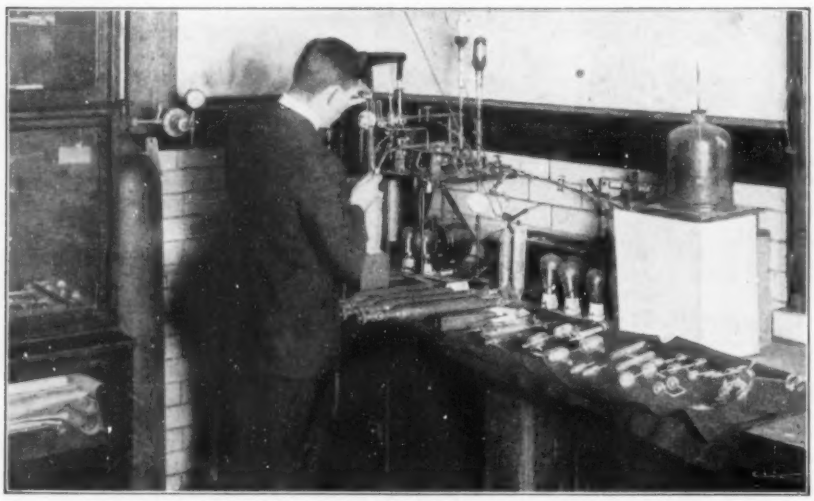
"Surely; we are a long way from perfection yet. This is a very new scientific baby—only three years old. No one can tell what bad habits it will exhibit when it is a little older, or how it will stand up under the requirements of new discoveries which are certain to be made. Even now it looks as if such an atom could not exist alone;



CONCAVE GRATING SPECTROSCOPE AT BUREAU OF STANDARDS

The grating A, throws a spectrum on a photographic plate at B; this may be placed anywhere on the circular rack. C is a reflecting mirror which sends light to the grating

that it must be one of many such, equally spaced like soldiers in open order. But whatever may be its ultimate fate, it is for the present a step in advance."



PREPARING VACUUM TUBES FOR USE IN THE SPECTROSCOPE

Much of our knowledge about atoms comes through the spectroscope which reveals their secrets not only in the laboratory of the physicist but in distant parts of the universe

"If we could only see an atom," said the visitor, "we could take all the remaining steps at once."

"That we cannot do at present," said the scientist. "But come with me," he added, rising, "and I'll show you the nearest thing to an atom that it is possible for us now to see."

He led the way out of his office to a small dark room opening out of the laboratory, and turned on a switch. The room as a whole remained dimly lighted, but the visitor saw a microscope with an intensely illuminated object on its stage.

"Look," said the scientist.

The visitor put his eye to the microscope. Against a dark background he saw a multitude of star-like points of light.

"Twinkle, twinkle little star!" he said.

"No," said the scientist. "You have spoken too quickly. Watch for a minute."

"WHY, of course!" said the visitor. "They are not twinkling; their brightness remains the same. They are only quivering and trembling. What are they?"

"Under the lens of the microscope," said the scientist, "there is a drop of liquid with extremely fine particles of solid matter suspended in it, just enough to give the liquid an opalescent appearance. The points which you see are these tiny little particles illuminated by the beam of light focussed upon them."

"But what keeps them in constant motion? I do not feel any vibration of machinery through the floor."

"No," said the scientist. "That question did not suggest itself to the mind of the man who first saw what you are seeing, for this discovery happened before the days of machinery. This is called the Brownian motion. The illuminated particles are being continually battered about in all directions by the impact of the liquid molecules surrounding them. These particles are the smallest things we can see under the microscope, but they are many times larger than a water molecule, and a molecule, being a conglomerate of atoms, is in turn much larger than an atom. But the water molecules are in rapid motion, milling about among one another like people in a loosely packed crowd. They are continually jostling these visible specks, which, although much more massive than the molecules that hit them, are yet perceptibly shaken by the impact. I cannot show you an atom; I cannot even show you a molecule; but you have seen the results of the impact of a molecule.

"And speaking of impacts," continued the scientist, "I see you are wearing a luminous watch on your wrist. Here is a rather strong magnifying glass; when I turn out the light, examine one of the bright spots on the dial."

As the light went out the visitor uttered an exclamation, and started to speak, but suddenly checked himself. After a minute's observation he said slowly:

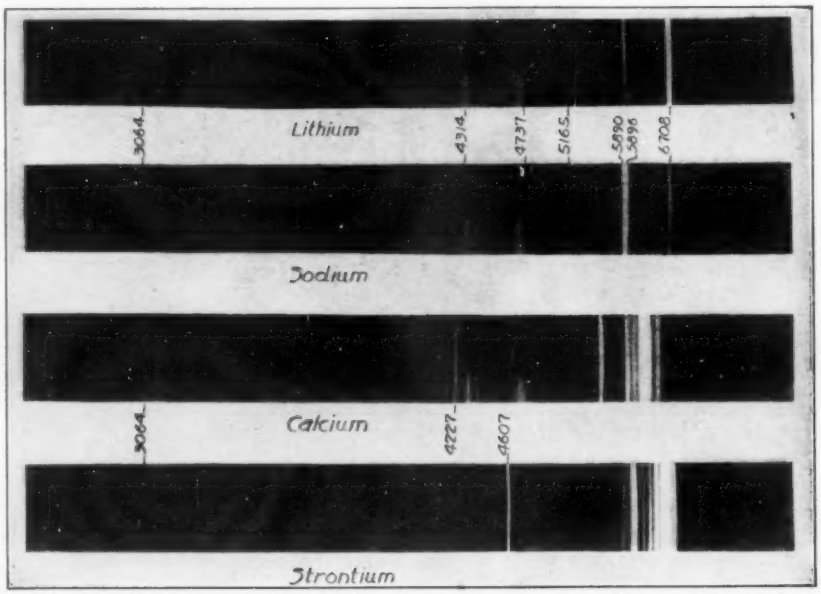
"I think these really twinkle. I was just about to say that this looked exactly like the spots of light in the little drop of water under the microscope."

"Exactly," said the scientist. "What appears to the unaided eye as a uniform glow you now see to be made up of myriads of tiny flashes of light, appearing for an instant, and then dying out."

"What causes them?"

"Each flash is caused by the impact of a particle shot out from a radium atom in the paint. The bulk of the paint is a special kind of sulfide of zinc. When one of these little bullets strikes a crystal of this compound there is a tiny flash of light. You are watching the disintegration of radium, atom by atom."

"Well," said the visitor as the light was turned on, "this has been almost as good as seeing an atom. I have had a crowded hour!"

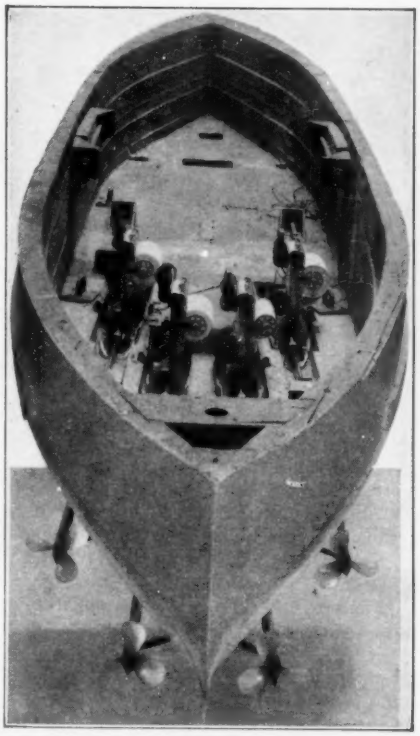


SPECTRUM PHOTOGRAPHS OF LIGHT EMITTED BY FOUR ELEMENTS

These are bright line spectra of the type obtainable from gases and vapors when made incandescent by electric discharge. Each wavelength emitted gives a bright line in the spectrum

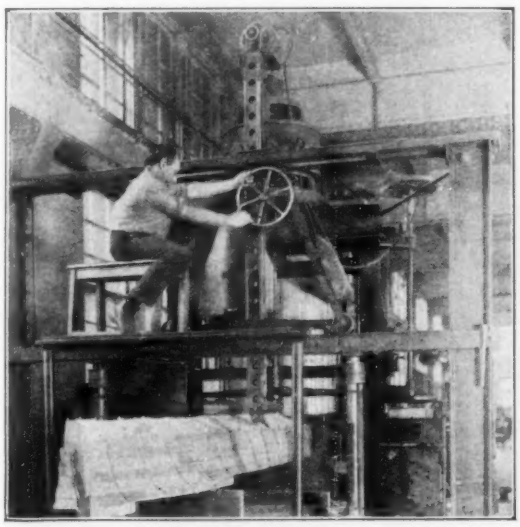
Towing Tests Solve Ship-power Problems

MORE than 2800 ships of the United States Navy, our Shipping Board, and of commercial fleets have been remarkably successful in operation because, before they were built, they were tested carefully in model form. At the Washington Navy Yard, a huge indoor pool for testing exact models of future ships is maintained, together with a staff of expert ship-model builders and testers. The behavior of the models under test conditions shows up errors in design of hull or balance, gives an exact indication of steam-power requirements, and solves many important problems for the designer. The enclosed concrete testing pool is 470 feet long, 42 feet wide, 14 feet deep in the center, and holds 1,000,000 gallons of water. Wave conditions, to imitate stormy seas, are produced by a hinged bulkhead at one end of the basin which swings to and fro under electrical control. The towing table consists of a 40-ton traveling crane that spans the pool. It is equipped with electrical motors that operate it at speeds ranging from one half knot to 15 knots an hour. The ship models are usually 20 feet long, some of them being towed by the crane while others are tested while operating on their own power. These latter models are equipped with small electric motors which drive the small propellers.



SELF-PROPELLED ➤

The power required by each motor and propeller on this model, is recorded on the paper rolls

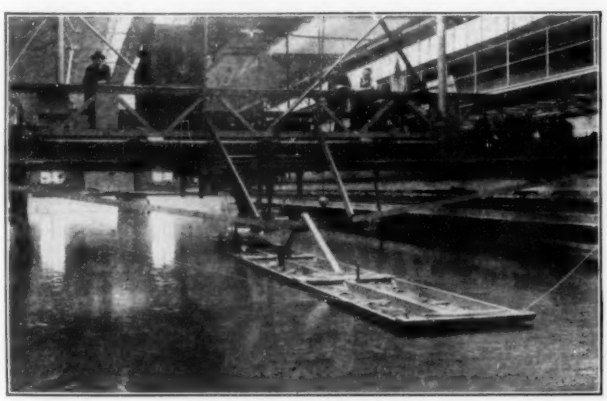


ROUGH SHAPING

This special machine was originated at the Washington Navy Yard. It cuts and shapes any design of model hull

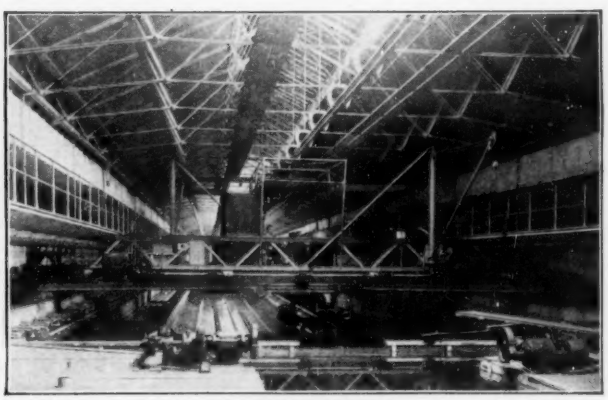
HAND-FINISHING THE BOTTOM

After rough machine work, all models are finished by hand. Redwood is used for most model hulls because it is satisfactory and cheap



BARGE-MODEL TEST

River barges are tested by towing with the crane, a good view of which is shown here. The crane is provided with a wide working platform



WAVE-MAKERS

In the foreground may be seen the mechanism that operates the wave-making bulkhead. Towing carriage, or crane, stands near end of pool

Our Point

STOP THAT NOISE!

A GROWING recognition of the right of the citizen to be protected against offenses to his senses of sight, smell, and hearing will mark the future of city administration. Already we have provisions designed to secure for the individual his proper share of light and air. Similarly we shall begin to recognize his right to protest against ugly surroundings in the shape of hideous architectural and engineering structures, and the plastering of buildings with advertisements until some sections of a city become an abomination.

But we think the most serious trespass against the comfort of the dwellers in cities, and especially in those of great size, is in the matter of noise; and for ear-splitting, nerve-shattering din, we know of nothing, not even the roar of an elevated railway, to compare with the racket of the riveting hammer.

We make no complaint against the pneumatic riveter as such; for it is one of the most ingenious and efficient of the many tools which have contributed to the great architectural and engineering achievements of the present age. Huge ocean liners, big bridges, and the towering office buildings of today are greatly indebted for their rapid and economical construction to the pneumatic riveter. But the time has come when the infernal racket of the machines should be prohibited on buildings that are being erected in districts which are already crowded with office or residential buildings. A substitute for the pneumatic riveter is available in electric welding which "has proved preferable to riveting where," as in the present case, "it offers some inherent advantage."

As we have recorded from time to time in these columns, electric welding has given satisfaction in full-size tests, carried out in shipbuilding, in machine shop work, and, above all, in the erection of a steel building—this last job having been done under strict engineering supervision, with a close accounting as to cost.

With such facts behind them, our municipal authorities will be justified in saying to the building contractor: "Stop that noise!"

AIRPORT IMPORTANCE

COLONEL LINDBERGH'S praiseworthy endeavor to make Congress "air-minded," successfully completed a short time ago, marks another important step in the progress of aviation in this country. With his splendid aid, and that of other veterans of the air, it will be only a matter of time until every city of any size in this country will have its municipal airport. In fact, with the ever-increasing net-work of air-mail and air-transport lines, cities without well-ordered landing fields may soon find themselves hopelessly out of date.

But no matter how great or how urgent may be the need of such a field, the construction of it should come only after careful thought and close study of the conditions to be met. The National Municipal League, 261 Broadway, New York, has recently published a supplement to its *Review*, entitled *Airports As a Factor In City Planning*, which should prove of great assistance to cities interested in airports. It discusses accessibility, area requirements, factors influencing area, site selection, future development, and costs; and contains diagrams of suggested layouts of efficient fields. Officials of cities contemplating the construction of airports will do well to obtain this supplement and study it carefully. Although not an exhaustive treatise of the subject, it will nevertheless settle many questions at once, while it inspires constructive thought on those problems most necessary of consideration.

Floyd Bennett

MEN, hardened of face, bored, blase, or burdened with a thousand cares, were seen to pause recently on Fifth Avenue, New York; cast a questioning glance up and down the street; and then, seemingly, a catch came into their throats; they gulped and their faces softened. The cause? Bunting and decorations fluttered gaily in the breeze—for the crew of the *Bremen* would soon arrive—but the flags of three nations that fluttered over the sidewalks from hundreds of buildings were at half mast. Valiant Floyd Bennett had died.

Bennett had "died in harness." An air victor himself, he wished, despite low health, to be the first to welcome to America and to aid three other victors. Thus did he wing his way toward lonely Greenly Island, contract fatal pneumonia, and die no less a hero than if he had crashed while on some momentous pioneering flight. He died as he had lived, a true gentleman and a courageous, a man whose life was devoted to the cause of aviation, one whose loyalty to his kind stood high within him.

To Bennett's memory the United States has paid homage by according him the honors of a naval hero dead "in line of service" and by interring his body near that of Peary. Peary was the first to reach the North Pole and Bennett was the first to pilot a machine of the air—Commander Byrd's *Josephine Ford*—over that same expanse of ice. The nation and the whole world mourns an irreparable loss. What more fitting, then, that Commander Byrd, whose second in command Bennett was, should render further tribute to his memory by naming his expedition The Floyd Bennett Antarctic Expedition and christening his chief airplane the *Floyd Bennett!*

DANGEROUS ENTHUSIASM

ALTHOUGH various methods of transmitting and receiving images of moving objects by radio (television) have been described at length in this and other publications, there is one point that must be stressed strongly. Be wary indeed of any smooth-tongued salesman who attempts to inveigle you into investing in a television promotion scheme.

While there are several reliable companies assiduously bent on developing worthwhile methods of television, there are (and there will be more) companies not so reliable who are more interested in moving the contents of your pocketbook than they are in moving pictures by radio. Any scheme for television development should be thoroughly investigated before investing. And the investigation should include not only the members of the company, but the television system as well. The services of someone well versed in radio will be needed here, but the end will be worth the trouble.

RAILROADS SHOULD STUDY AIR RESISTANCE

WHEN *Railway Age* tells us that "atmospheric resistance absorbs something like one half of the power of a train going 60 miles per hour and over," it is time for railroad management to sit up and take notice. The total resistance of a train is made up of the internal frictional resistance of the bearings, the rolling resistance between the wheels and the track, and

# of View

the atmospheric resistance due to the thrusting aside or displacement of the air by the onrushing train. The first has been greatly reduced by the use of roller bearings; the second by accurately turned wheels, heavy rails, and careful track maintenance; but as regards the third and most important, reduction of air resistance, nothing whatsoever has been done. It would look as though the designers of locomotives and trains were ignorant of its existence.

Careful streamlining has made possible an airplane speed of over 318 miles per hour—the total neglect of it in railroad operation costs, at high speed, about one half of the locomotive power.

Can our fast trains be streamlined? Undoubtedly they can, and at a cost that would be by no means prohibitive. The roof, instead of curving down at the vestibules, should run straight across the gap, with flexible connections, as in the latest Pullman vestibules, with the roof of the adjoining cars.

As matters now stand, the air, closing in behind the locomotive, exerts its pressure upon the trucks of each car of the train. In a 12-car Pullman, there are 24 trucks exposed to atmospheric pressure. At 60 to 75 miles per hour the consumption of power in forcing these trucks against the air is enormous. In streamlining the train, the sides of the cars would be extended down, in the form of light steel plating, and curved inwardly to the rails, with sufficient clearance to avoid switches, and other projections. On a train streamlined in this way the air resistance would be reduced to the head resistance of the locomotive and the friction of the air moving rapidly along the smooth roof and sides of the train.

This proposal is not new. It was tried out experimentally 30 years ago on (if we remember rightly) the Baltimore and Ohio Railroad, and the results were highly satisfactory. True, it would cost money; but if it saved only one half of the engine power (50 percent) now expended in overcoming wind resistance, the cost would easily be recovered and a large permanent saving would be shown in the fuel bill.

A REAL ACCOMPLISHMENT

WHAT outstanding achievement has been made in the Coolidge administration, will be a question hurled with increasing frequency as the first Tuesday after the first Monday in November draws near.

Well, for one thing, there is maple syrup. Heretofore, the only objection to good old Vermont maple syrup has been that there was not enough of it. The morning pancakes of too many of us have been covered with an insipid concoction of "imitation maple" made from a number of ingredients, the principal one in most formulas being Greek hay seed, or fenugreek, as it is known in the more polite scientific circles. Other ingredients often used to simulate maple flavor have been elm bark, celery seed, hickory bark, coffee, chickory and vanillin.

Now J. W. Sale and J. B. Wilson, chemists of the Food, Drug and Insecticide Division, have perfected a process for making a true maple flavoring product. All you do is mix it with ordinary sugar syrup and you have all the pleasure of the perfect sap. They have patented the process and dedicated it to the public, so that anyone may use it freely. If they can only give enough publicity to their accomplishment, they should be able to swing the entire pancake-eating vote of the country. The up to now solid cornpone vote will be completely disintegrated.

To What End?

FORMERLY, in India, worshippers of Vishnu are said to have cast themselves in a frenzy of fanaticism under the wheels of the great ceremonial car which contained an idol of "Vishnu, Lord of the World," or Juggernaut. Besides serving no purpose, their self-immolation was against the principles of Vishnu's teaching.

The recent sacrifice of his life by Frank Lockhart, racing car driver, to the whim of the modern God of Speed, reminds us of the car of Juggernaut. He cast himself, not under the wheels, but on them, forward at such a terrific rate of speed that his life was forfeit. But why? What question was he trying to solve? That of human endurance or the capabilities of a machine? The first has already been solved in the air to a greater extent than anyone could expect to solve it on land. And in the air there is a definite practical need for this knowledge. The second has been, and may still be, solved in the air, the shop, or the laboratory. Little can be learned by ground racing that cannot be accurately determined otherwise. And it is obvious that such great land speed can never have a tiny fraction of the value of great air speeds.

It is regrettable that this brave young man, who had more "guts" than practical foresight, lost his life, but it is to be wondered what gain has come of his sacrifice. Speed-mania, which has given us our rushing, tense, and tumultuous civilization, has also contributed much to our modern efficiency, has caused much of the progress of which we boast, but purposeless speed should not be countenanced. It is time a protest is registered; public sentiment should stand firmly against any repetition of this meaningless exhibition of devotion to the God of Speed.

BRIDGES SUPERIOR TO TUNNELS

FOR many years the SCIENTIFIC AMERICAN has urged that bridges are superior to tunnels for the crossing of broad rivers and waterways. They cost less to build, less to maintain, and have a far greater traffic capacity. This is proved by a comparison of two recently completed structures: The Delaware River Bridge at Philadelphia and the Holland Tunnel below the Hudson River.

Figures given out by the bridge authorities show that the bridge cost 37,000,000 dollars and the tunnel 48,000,000 dollars. Maintenance costs for the bridge are about 375,000 dollars per year; for the tunnel the estimate, due mainly to the costly ventilation, is about 1,500,000 dollars per year. The bridge affords three lanes of traffic, the tunnel only two. The hourly capacity for the tunnel is only about one half that of the bridge, yet the toll for automobiles is twice as great.

These comparisons have deep interest for the people of Philadelphia who strongly advocated the building of a bridge in the face of the powerful combination of interests that favored the construction of a tunnel. New York faces the same problem. In a few years the great suspension bridge at Washington Heights will be completed and the proposed bridge at 59th Street must be taken in hand. Otherwise, at least four tunnels must be built to equal the bridge capacity, at a greater first cost and involving a far greater cost for operation. And the cost will be handed along to the public.

Can We Grow Our Own Rubber?

Guayule, a Native American Rubber-producing Shrub, Is Being Cultivated on a Large Scale in California.

By D. T. MacDOUGAL, Ph.D.
Associate in Plant Biology, Carnegie Institution of Washington
Member American Philosophical Society
Corresponding Editor, SCIENTIFIC AMERICAN

YOUNG GUAYULE PLANT

Guayule is pronounced "'wy-oō-le," the initial letter "g" being all but silent

COMPANIONS of Cortez returning to Spain early in the 16th century told Peter Martyr of the Royal Council of Indian affairs of a game of tennis popular among the people of southern Mexico. It was said that "Their balls are made of the juice of a vine that climbs over the trees, as hop vines clamber among the hedges. They cook the juice of these plants until it hardens in the fire, after which one shapes the mass as he pleases, giving it the form he chooses. It is alleged that the roots of this herb, when cooked, give them their weight; at all events I do not understand how these heavy balls are so elastic that when they touch the ground, even though lightly thrown, they spring into the air with the most incredible leaps."

THIS, with other information as to water-proofing cloaks of matting of fiber, constitutes the earliest knowledge of the use of rubber.

Not until the last half of the 19th century was any additional utilization of caoutchouc made. In this period it began to be employed in rain-coats, shoes, hose-pipes, and other articles. No extended demand, however, was made for it until inflammable gasoline, coming as a by-product of oil-refining, was squirted into smoothly bored steel cylinders and ignited rhythmically and the internal combustion engine was born. Horses were unhooked from hundreds of thousands of vehicles, gasoline engines were hidden under the drivers' seats and the commonplace daily world quickened its pace from five to 25 miles per hour. Interest then shifted from railways to highways and from common carriers to individual transportation.

This increased speed called for cushioning against jolts and jars to the human anatomy and against breakage of material carried as loads over rough roads. Cores or rings or air enclosed in circular rubber tubes were attached to the rims of wheels to mitigate bumps, save springs and abolish noise: The epoch of rubber was initiated.

SO common has the pneumatic tube become that the number kept inflated in the United States is as great as the pairs of shoes worn by the populace; the count of horse-shoes could also be included without disturbing the equation.

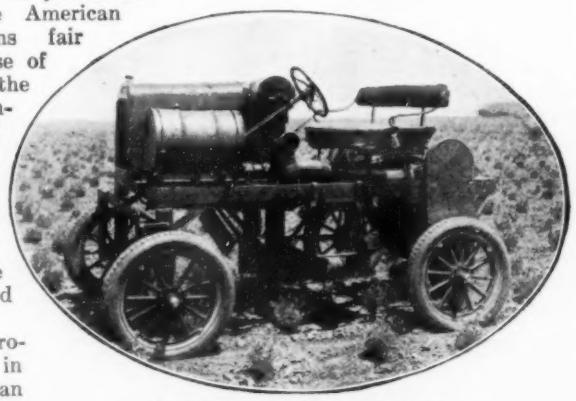
This implies that about six pounds of rubber is necessary on the average for every man, woman and child in America. The total American consumption of rubber requires 66 percent of the world's production, and a further analysis indicates that about 81 percent of the rubber coming into the market every year is made into tires and tubes by the use of which the hypothetical American speed of 25 miles per hour may be maintained.

With this material assuming such importance in daily life that it ranks below only steel, sugar, textiles and wood, problems arise which are not to be solved by statistics of production and population. The American consumer who seems fair to continue in his use of more than half the amount produced, controls less than one half of 1 percent of the tropical areas in which rubber trees may be grown profitably. No part of this small area is within the boundaries of the United States.

Material, whether produced in our own or in dependencies of European powers, must be carried long distances by sea to reach American factories. A country so highly mechanized would be inconvenienced or crippled by a serious interruption of the rubber supply for two or three months. Moreover, there is not in existence at one time enough rubber to meet the world's needs for more than five or six months.

The economic stability of a country depends upon the degree to which it is self-maintenant as to its manufactures and upon the main supplies of raw material within its borders. No dreams of denationalization of the world or of socialization of industries can annul or modify this principle in any serious manner. The results which could be expected if it were necessary to bring our main supply of iron, coal, sugar or wood from the other side of the world are so obvious that the desirability of the production of rubber within a reasonable radius of the factories which convert it into useful articles need not be argued.

THIS must not be taken to mean that effort or other expenditures should be wastefully directed to the production of the total amount of rubber used in a country. It is, however, the soundest kind of common sense that the capacity of America for producing rubber should be developed to an extent in which some land might be more profitably used than at present, unused areas be brought into cultivation, and that other plants furnishing caoutchouc should be exploited.



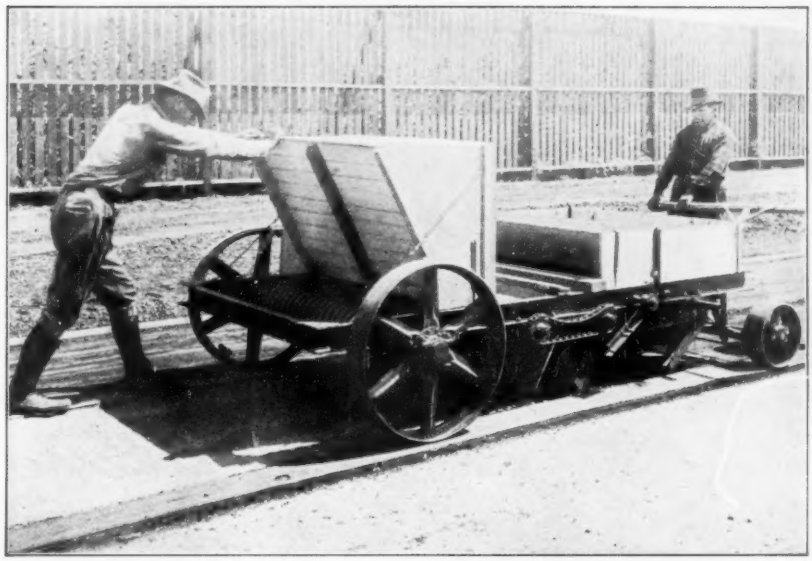
GATHERING GUAYULE SEED

A set of revolving brushes and a "vacuum cleaner" device are removing the dry seeds from a crop of young, pedigreed plants

The main supply of rubber comes from hevea trees of the tropics. Thousands of other species, hundreds of which are native to North America, show some caoutchouc in their milky juices or in the thin-walled cells of the wood. Plants, the dried stems, leaves and branches of which show as much as 1 percent of rubber, are numerous. Several of these cover extensive areas of wild land and constitute a reserve supply which might be profitably drawn upon if raw rubber rose to ten dollars per pound. A similar state of affairs with regard to starch prevails. Grains and potatoes furnish the main supply. In extremity thousands of other plants might be used as sources. Lastly, any attempt to produce rubber within the limits of the United States upon any basis except that of a self-sustaining branch of agriculture would be justifiable only on a basis of the gravest menace to the national safety. The only pound of rubber of real importance is one in which the grower has made a profitable use of his land, labor received a fair compensation and the manufacturer a safe return on his capital and operation.

SUCH considerations must be taken into account in the widespread agitation now being made as to the production of rubber in America. The first successful attempt to grow rubber in the United States on a self-sustaining basis without government subsidy or aid and as a sound commercial project is to be credited to the Intercontinental Rubber Company. This company, with its allied interests, has been engaged in the extraction of gum from dried shrubs of the guayule plant collected chiefly from its extensive holdings in northern Mexico for 22 years. Its output has run as high as ten million pounds monthly, with a total from the guayule plant of about 150 million pounds annually.

From these figures it is evident that guayule is second only to hevea in contributing to the world's supply. In making this yield, however, the history of all wild plants utilized in manufactured products is illustrated. The peak of the manufacture of material was shortly followed by decimation of the stand of wild plants. It is estimated that the "forest of guayule" which covers about 130,000 square miles in Mexico and southern Texas could not be managed to yield more than 5000 tons of rubber annually.



A SPECIAL SEEDER OPERATING IN THE NURSERY

The seedlings are grown in 180 foot rows. Seed for 25,000,000 plants was sown last April. The seeder runs on wooden tracks and will sow enough seed for a 20-acre field in an hour

WHEN it becomes evident that attempts at a greater production from wild plants would mean a dwindling industry, a serious scheme for research and experimentation was undertaken to bring the wild plant into cultivation. The implied experimentation was placed under the hands of Dr. W. B. MacCallum, whose previous experience and personal qualities gave him special fitness for the "domestication" or, more properly speaking, the subjugation of the wild plant.

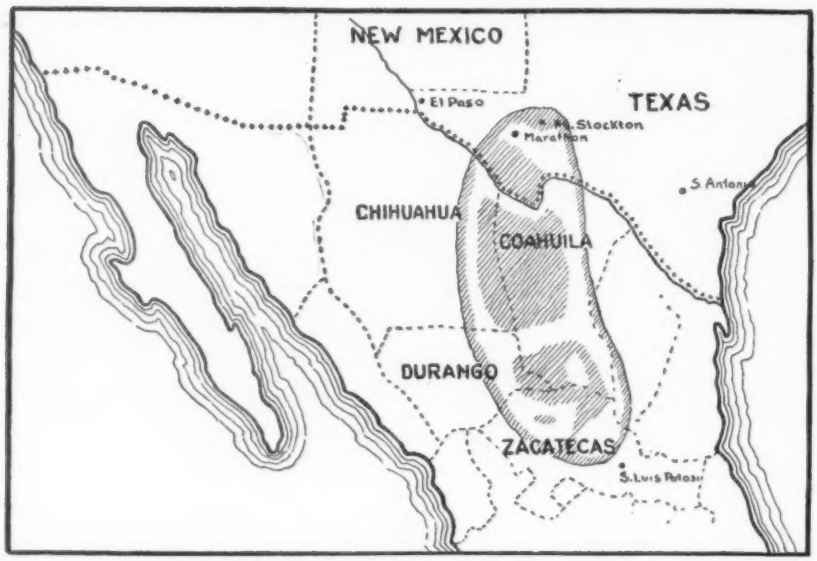
The technical problems pertaining to the harvesting and germination of seed, the selection from the vast number of recognizable varieties of the half dozen which might be most profitably grown in fields, and the determination of the hundreds of details of practice which make for success or failure of any crop plant were studied in experimental plots and under shelter in Mexico, Arizona and California. As an onlooker and frequent visitor to the plantation the author is vividly conscious of the hundreds of discouraging features encountered. The combination of the facility of a skilled plant physiologist, and the resourcefulness of a trained engineer with a total expenditure running into seven figures was necessary to complete the first stage of the project. At this juncture the management had acquired small lots of seeds of less than a dozen varieties of the shrub, the seeds of which could be used to grow plants with a higher percentage of rubber than the wild plants, and some pretty definite knowledge of a practicable method of growing crops of the improved varieties. This, with some clear ideas as to the soil conditions and climate best suited for guayule, represented the results of 14 years work.

GUAYULE is now to be included among the plants which may be grown profitably upon some hundreds of thousands of acres within the limits of the United States. Its cultivation in other countries is a matter for further experimentation. The domestication of a wild plant, so that it may be grown as a field crop within the brief period indicated, is without parallel in the history of agriculture, and is an accomplishment which for speed keeps pace with scientific research and invention during the last 20 years. That the best possible procedure in all phases of the industry has been found is highly improbable; for comparative example, we are still improving the yield and methods of milling wheat after having this plant under cultivation for five to ten thousand years.

Many thousands of wild plants and especially trees are grown under control. The rubber plantations of the Far East have come from seeds of hevea collected from trees on the upper Amazon about a half century ago. So far, the record of any actual im-

MAKING VARIETY TESTS

The plantation described in the article is situated at Salinas, California. Guayule shrubs require frost but no irrigation



NATURAL RANGE OF THE WILD GUAYULE PLANT

There are over 1000 varieties of the wild plant. At Salinas, 2600 acres are under actual cultivation. Salinas is in California, near the seacoast, 100 miles south of San Francisco

provement of strains or modification of the tree by man are scanty.

The essential feature of a field crop is that its seeds should be made to germinate so nearly simultaneously, and the plantlets to grow so uniformly, that hundreds of thousands or millions may mature their grain, fiber or other products at the same time. If some heads of wheat in a field ripened in June, others in July and others stayed "in the milk" until August the difficulties of the farmer would be much greater than those of which he now complains.

THE production of a crop of guayule on the California plantations of the organization mentioned involves the following program: Seeds from desirable varieties having been gathered by specially devised harvesting machines from standing shrubs, which are not injured by the process, they are subjected to special treatment so that 98 out of every hundred germinate. This is literally first aid, since in nature many of the seeds may not sprout for weeks, being subject to rot and destruction. This would result in a lot of plants of widely different ages and development. Sowed in the nursery in the spring the plantlets come up of uniform height and in about nine months are ready for transplantation to fields. There they are spaced in rows to give each one about six square feet of soil, and allowing 7260 plants to the acre.

Every one of these young plants is to be regarded as a factory unit driven by its own solar engine which in three or four years will build up its own roots, shoots and leaves until it attains an average weight when dried of one and three quarters pounds, of which 12 to 14 percent may be pure gum or rubber. The separate plants are handled but twice on their way from the seed-beds to the fields.

The remainder of the transplantation process is mechanized. Such a procedure is in accord with a principle now coming into recognition, that the most successful agriculture is that in which the greatest production of an acre is accomplished with the least expenditure of man power.

The tree rubber of the Far East is produced under a system in which the daily work of one man for a year results in the production of 1600 pounds of rubber. Even in the present initial stage of culture, with possibilities of improvement, the work of one man on a guayule plantation for a year brings 25,000 pounds of rubber.

The planted fields of guayule, as shown in the illustration, must be kept free from weeds for the three or four years during which a profitable increase in the size and rubber content goes on. Actual increase of the amount of production on each acre continues for 10 or more years, but the rate of accretion slows down so that as the end of this period nears the caoutchouc formed yearly would barely meet the annual cost of tillage.

THE condition just described is, however, an advantage in another way to the cultivator: if the market or the milling facilities should be overcrowded at the time of the fourth year harvest, the crop may be allowed to stand for as long as four years more, during which there will be a sufficient increase to meet interest and maintenance charges, as would be the case in certain forestry operations. In fact, guayule culture is something like a forestry project of short cycle.

Very few cultivated plants of any kind reach their greatest usefulness or productivity in the regions in which they are indigenous. The ancestors of maize were native in the elevated desert regions of southern Mexico in which the climate is widely different from that of New York or Iowa. Maize culture has been carried northward over 30 degrees of latitude, from southern Mexico and from coast to coast and it may encircle the world.

Briefly put, the production of rubber by guayule is best conducted in a region in which a part of the season has precipitation, soil-moisture supply and a temperature favorable to growth of stems and roots and to the formations of sugars in the leaves, followed by periods of higher temperatures with lessened precipitation.

THE TRANSPLANTER SETTING FOUR ROWS AT ONE TIME

This is much like the common cabbage and tobacco transplanter used elsewhere. A small plow opens a drill ahead of the men, the seedling is placed in it and a following tool covers it

What pattern may be made by guayule on the map during the next half century can not be foretold, although the experts in the project doubtless have well grounded opinions on the matter. The next step will doubtless be the discrimination among varieties, in order to find the ones most suitable for the coldest regions for the least water supply; also for long seasons, for short seasons, for various types of soils, for three year crops, for four year crops and perhaps for wild sowing on grazing areas.

WHEN the crop on a certain area has reached the age of three or four years and the percentage of rubber is found to be satisfactory, the plants are all pulled up with the roots attached, dried in the open air and crushed by being sent through series of rolls in the presence of water. According to Dr. Spence's technical account—"After crushing, the mass is fed continuously with additional water to a tube mill or mills. These mills contain flint pebbles and revolve slowly on a horizontal axis. Their action on the shrub depends on the rolling motion of the pebbles in the presence of water and results in a further disintegration of the fiber out of the shrub and the agglomeration, or 'worming,' of the rubber substance into small, round, spongy particles, which vary in size with the condition of the shrub and the time of milling. The fine particles of rubber, or 'worms' being lighter than water, float on the surface of the discharge liquor from these tube mills, while the bulk of the fiber and other impurities sinks and can be readily separated. The rubber 'worms' which rise to the surface of the settling tanks into which the liquor from the tube mills is run, are skimmed off and collected. The 'worms' are further purified and are then worked into sheets on sheeting rolls, well washed and dried."

TWO YEARS OLD

Guayule is Parthenium argentatum. *Argentatum refers to the plant's silvery leaves*

CULTIVATING—SIX MONTHS AFTER TRANSPLANTING

A modified farm tractor carrying a cultivator rigidly attached to its front, is employed. This enables the operator to watch his work closely. Four rows are covered at each trip

Tests under the direction of the United States Bureau of Standards "indicate that, when properly prepared, the rubber from guayule will compare favorably with that from hevea and can be used to a large extent therefore without appreciable diminution of the tensile elongation product" (Technological Papers, United States Bureau of Standards, Number 353, 1927).

THE PLANT NURSERY

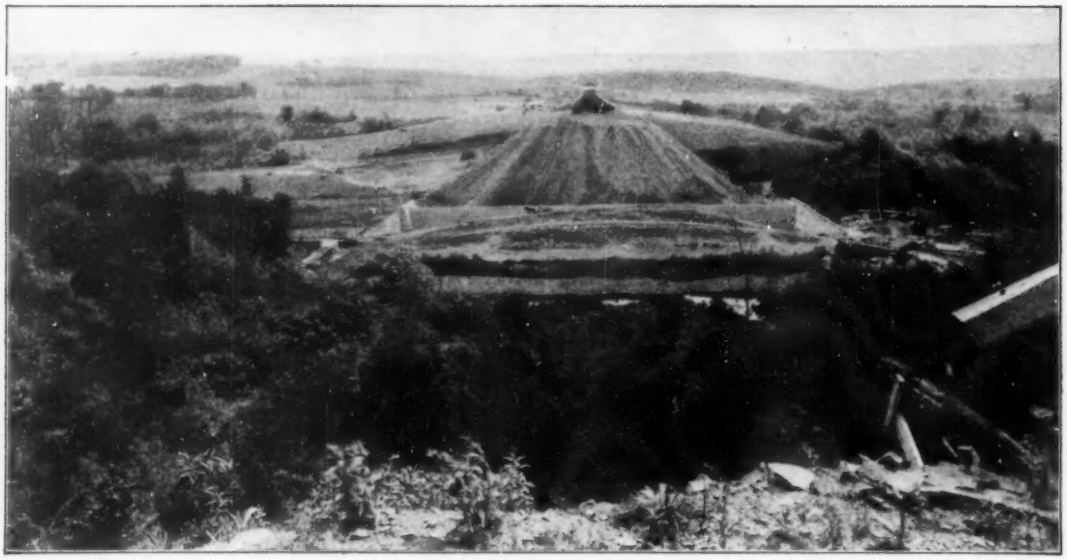
Part of the seed beds in which 18,000,000 plants, four months old, are growing

THE experiments with the guayule shrub, described above, have resulted in the domestication of a wild plant within 16 years and the production of rubber as a field crop with a cycle of three or four years. The application of engineering principles, including the use of specially designed machinery, has made it possible for one laborer on the prevailing wage standards to do the work of 16 on a tree plantation in the tropics. The profitable cultivation of rubber-bearing plants has been extended from the tropics northward through 25 degrees of latitude, and from the moist tropics to regions in which the rainfall is too low for the advantageous production of grains.

This addition to the agricultural products of temperate America is not to be regarded as a means of putting the tree plantations of the Far East out of business; such an effect would be highly disadvantageous to the consumers of rubber everywhere. To the economists who might call attention to the fact that the area in the tropics in which tree rubber might be produced is ten times that now occupied, it is to be pointed out that the critical feature of the industry is power. It is generally assumed that tropical natives may be relied upon to furnish indefinite numbers of laborers. In contrast with this careless view it may be said that attempts to expand rubber production in Malaya where 750,000 coolies are already employed have been checked by lack of man power. It may be safely predicted that consumption will soon increase more rapidly and that other countries than the United States will require the entire tropical crop.

IN such a case it is of interest to know that 40,000 farmers and mechanics employed in guayule cultivation could meet the need of the United States during the next 10 or 15 years.

The possibilities of such production outside the tropics and in the North Temperate zone would in itself be valuable insurance against many hazards including those of diseases of rubber producing trees. When it is recalled that 92 percent of a raw material that has become essential to the material operations of modern civilization must now be brought overseas and half way around the world, and that the accumulation in America is never more than sufficient to keep factories in operation for more than 100 days, the importance of rubber culture as described becomes apparent.



LIKE A GROWING MOUNTAIN

Striking view of the advancing fill, showing the beautiful valley which it traverses. To get an idea of the size, note the horse and wagon crossing on the road beside the culvert. In the upper left corner may be seen the steel bridge which the fill supplants

A Mammoth Railroad Fill

Original Timber Trestle Is Replaced, First By Steel Bridge, Then By Massive Earth Fill

By J. BERNARD WALKER

THE development of the American railroad from its crude beginning to its present-day costly perfection has been marked by three rather well defined stages—the pioneer; the intermediate; and the modern. Those of us who were privileged to attend the Centennial of the Baltimore and Ohio Railroad, saw, in that truly magnificent spectacle, the complete panorama.

When the pioneer roads were undertaken, experience was wanting and capital was scarce. It was necessary to cut the coat according to the cloth. If the roads were to be built at all, they must be built cheaply.

HENCE, when the engineer who located the line came to a hill, he ran around it rather than through it, following the contours of the hillside, disturbing the ground as little as possible, and avoiding deep cuts and heavy fills. This economy called for sharp curves and steep grades.

Structural iron and steel were scarce and their price was prohibitive. So when the engineer came to a valley or canyon that was too deep for a fill, he set up a sawmill in the forests (always within reach) and spanned the gap, quickly and cheaply, with lofty wood trestles. He drove wood piling piers into the bed of the rivers, and crossed them by that remarkable framed structure, the Howe truss bridge. Timber for these trestles and bridges was not only abundant but cheap, and the only iron or steel requirement was some simple round bars, threaded at the ends. Thus, by these simple methods and at remarkably low cost, did our forefathers, during the first railroad era, push boldly through the forests and mountains of virgin America.

FROM UNDER THE CULVERT

This huge culvert, 45 feet wide and 25 feet high, was necessary to carry heavy flood waters of the creek through the new fill

Then followed the second period, from the Civil War to the close of the century, when the nation turned its energies to the opening up of the great western territory. Thanks to the Bessemer process and the development of the steel mills, excellent structural steel became available at a cost that was not prohibitive, and the network of tracks began to spread with amazing rapidity—the western extensions still using soft wood timber for bridging and ties; the eastern roads, now better established, making use of steel in increasing quantity.

By the opening of the Twentieth Century, the period of construction closed; henceforth, as the roads prospered and capital became abundant, the gigantic task of reconstructing the pioneer roads to meet the engineering and economic demands of the day was boldly faced and carried through.

DURING the past three decades, hundreds of millions of dollars have been spent in relocating certain stretches of railroad; in reducing curvature and grades; in replacing bridges, both wooden and steel, with heavy steel structures capable of carrying the heavy locomotives and cars of today.

The modern railroad, as thus rebuilt,

aims at permanence and the reduction of the repair and replacement bill to a minimum. A notable instance of this is seen in the practice, where it is possible, of substituting solid rock or earth embankments in place of wood or steel viaducts. Sometimes the fill is made around the existing viaducts, but preferably, where this is possible, the great fill is located independently of the old line, and undesirable curvature is eliminated.

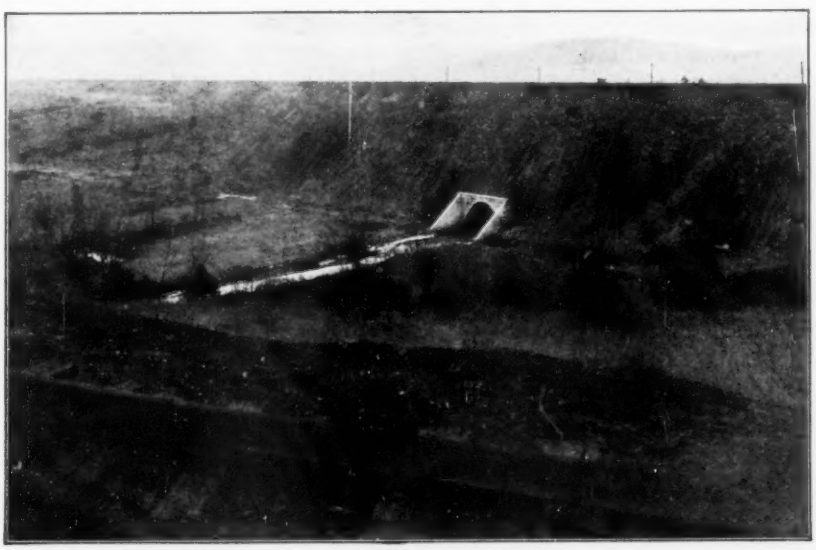
A notable instance of this revision is shown in the accompanying illustrations of the great fill at Ringtown on the Catawissa Branch of the Reading Company, which has taken the place of the well-known steel viaduct at that location. The line on which the viaduct is located carries a heavy coal traffic, to handle which, the locomotives and cars have been greatly enlarged in power and capacity and the length of the trains increased. To meet this exacting service the roadbed, bridges and track have been steadily improved, the weight of the steel rails, as elsewhere on this system, having reached the high figure of 130 pounds per yard.

HOW THE FILL WAS BUILT

Behind the loading station is a train load of material which will be discharged into work-cars and dumped over curve at end of the fill. The work-car track was advanced as the fill progressed

ORIGINALLY, the valley of Ringtown was crossed by a timber trestle which figured in the great Molly McGuire riots, when a determined, but unsuccessful, attempt was made to burn it down. It differed constructively from the great timber viaducts on the western railroads, several of which are still in service. In the latter the vertical posts are solid timbers, 12 inches and sometimes 14 inches square, and they are built in decks, with transverse caps of the same dimensions, the top deck consisting of 8 inch by 16 inch stringers, bolted together in pairs, upon which the ties were bolted down. Probably because of the difficulty of obtaining timbers of this size for the Ringtown trestle, the verticals were built of two timbers, bolted together with separator blocks between. An excellent feature was the abundant provision of longitudinal braces in each deck of the structure—a feature in which the western wooden viaducts were apt to be wanting, at times with disastrous results. The average space between the bents was 16 feet; but in this structure the span was increased, the necessary carrying strength being secured by providing a stiffening truss in each span.

In the year 1897 the wooden structure was replaced by a steel viaduct. This consisted of steel piers, consisting each of a pair of widely spaced steel bents, carrying plate girders with shallow deck trusses between the piers. This bridge gave good service until the year 1922, when it was determined to relocate the line straight across the valley at a short distance from the existing location. The work was commenced on April 4, 1922 and completed on November 19, 1927. The new line was placed in service on September 11, 1927. The length of the fill is 3340 feet; its maximum height is 116 feet; and its maximum width at base 368 feet. It contains 1,352,613 cubic yards of material, and the total cost was 1,200,000 dollars.



THE COMPLETED FILL

View taken from the track leading to the old steel bridge. Here may be seen the massive culvert which passes through the fill. For comparison of size, note group of men on fill over culvert

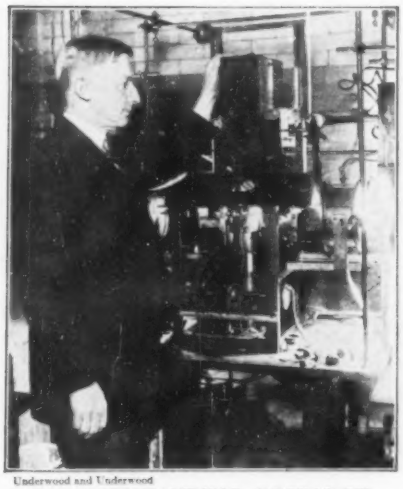
THE stream which flows through the valley is subject at times to heavy floods, to provide for which it was necessary, before making the fill, to build a massive concrete culvert from toe to toe of the embankment slopes. It is 45 feet wide, 25 feet high above bed of stream, and measures 430 feet between the ends of the retaining walls.

The material for the fill was brought to the site in standard cars, unloaded to small work cars, hauled out and dumped on a curve at the end of the fill, the empties being hauled back to the transfer house which was located at the far end of the fill.

¶ *While the Ringtown Fill, described in the foregoing story, represents what is probably the greatest earth fill on any railroad, the amount of soil used cannot compare with that used in some earth-fill dams. A number of these, of tremendous size, have been constructed, but the dam planned for a hydro-electric development of the Lexington Water Power Company (a subsidiary of the General Gas and Electric Corporation) near Columbia, South Carolina, is said to be the largest.*

This dam, representing the major item of construction, will be 8000 feet long and 208 feet high. Contract for the dam's construction was let in August, 1927.

From the Scrap-book of Science—



Underwood and Underwood

FOR OUTSTANDING RESEARCH

Professor William R. Harkins of the physical chemistry department of the University of Chicago was recently awarded the Willard Gibbs Medal by the American Chemical Society for researches, one of which will have importance commercially in lubrication

P and A

BILLIARD TABLE

Slate splitting is an art acquired by long practice. Welsh quarries employ many skilled men but it is unusual as a Thames-side occupation. In this illustration, two workmen are "floating" a billiard table bed made of five slabs of slate, planed and joined together, at the Dinorwic Slate Wharf, Rotherhithe. This is done by rubbing the slabs with floats which are made of metal boxes filled with a mixture of sand and water. Care must be used in selecting the most suitable slabs

UNUSUAL HYBRID

Three fourths ass and one fourth horse, this animal was foaled by a mule and was recently acquired by the University of Nebraska. Hitherto the opinion has been that a mule cannot become a mother. Ichabod, as this animal is called, is said to be strong and well developed, and travels with a gait similar to that of the horse. He was born on a Nebraska farm

Wide World

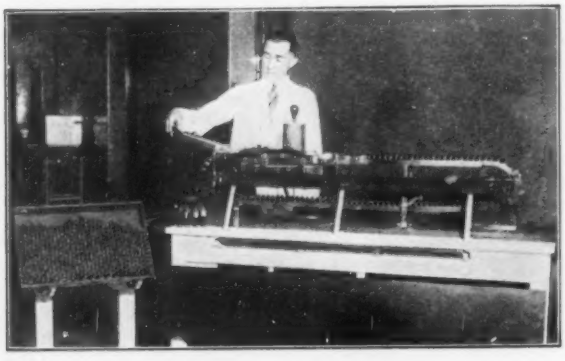
ASTRONOMICAL BALL

At the American Museum of Natural History this great silver ball-map of the heavens, 12 inches in diameter and valued at 108,000 dollars, was recently placed on exhibition. It is 400 years old and is the work of Tycho Brahe, the noted astronomer

P and A

FOR DIABETES TREATMENT

Although not substantiated by independent research, the treatment for diabetes developed by a Kansas City physician will be practiced in this unique steel tank which is part of a million dollar sanitarium being built in Cleveland. The treatment is kept secret but it is understood that introduction of oxygen under varying pressures into the blood of the patient is one of its features. The tank is 64 feet high, contains five stories and will accommodate 40 patients. It is connected with a 60-patient sanitarium by a covered passageway

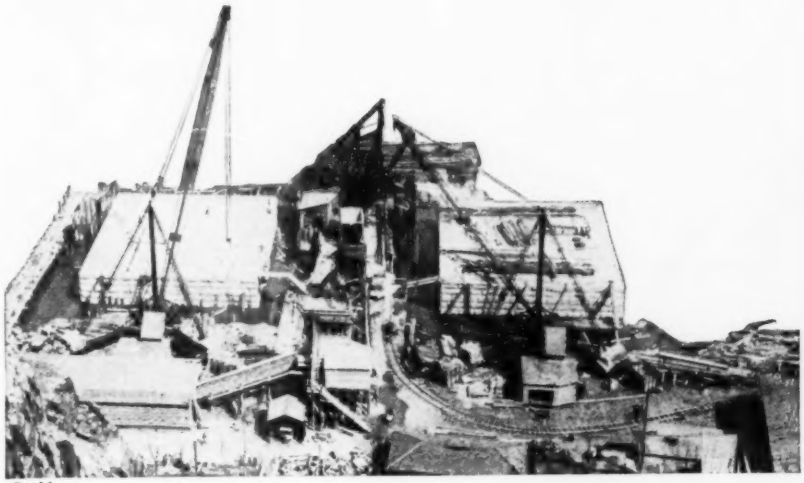


INVENTIVE CHEMIST

Percy W. LeDuc, chemist of the Biochemic Division, Bureau of Animal Husbandry, Department of Agriculture, saves the government thousands of dollars a year by his inventions. He is shown with his machine which covers with glue the stoppers of tuberculin bottles. The use of sealing wax was more costly

P and A

Camera Shots of Scientific Events



P and A

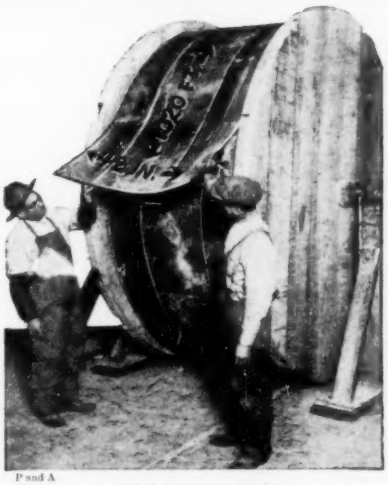
BRIDGE-TO-BE

Satisfactory progress is being made in the construction of the massive piers that will sustain the load of the future bridge spanning the Hudson River from Fort Lee, New Jersey, to Fort Washington, New York City. This illustration shows the piers on the New Jersey side completed, ready for the main columns which will be of silicon steel, encased with masonry. Bed rock was reached at depths varying from 35 to 75 feet below water. A steel coffer-dam protected the work

P and A

"THANK YOU-U-U!"

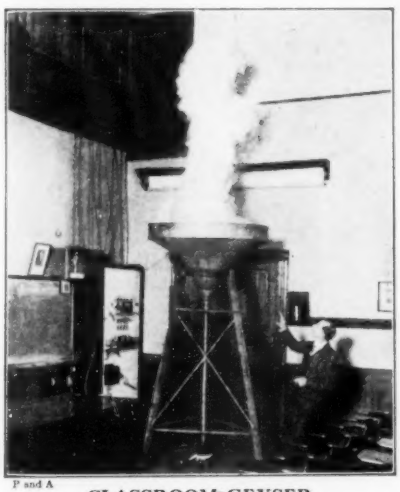
So says the voice from this new automatic cigarette vending machine; and follows this by the spoken slogan of the particular brand purchased. A battery of these venders has been installed in New York City in a Broadway cigar store of a national system



P and A

BIGGEST BELT

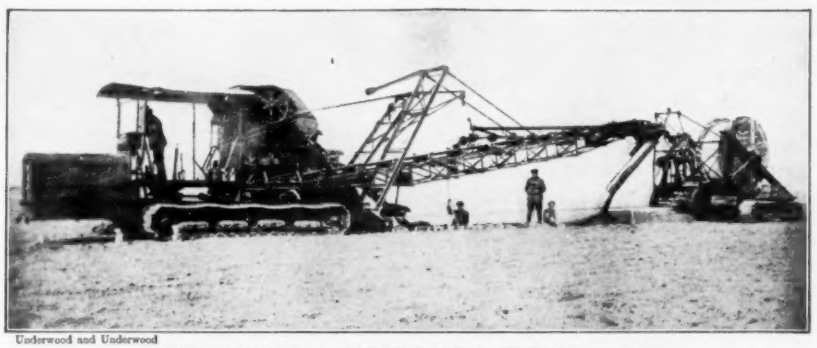
What is said to be the largest power belt in the world has just been built at Oakland, California. It is 1020 feet long, 42 inches wide, and is valued at 9000 dollars. It contains 10,000 pounds of rubber and 9000 pounds of cotton fabric in eight plies



P and A

CLASSROOM GEYSER

Professor B. J. Spence, of Northwestern University, built this model of a geyser to work on the principle suggested by Bunsen in 1847. Water and steam spout to a height of six feet every 10 to 15 minutes. Gas flames (shown on floor) heat the water in the tapered tube until that at the bottom reaches the boiling point—higher than usual because of pressure above; the hot water expands, rises, and becomes steam since its critical temperature is lower; and the steam, rising rapidly, carries the water above it six feet into the air



Underwood and Underwood

TRENCH DIGGER, CABLE LAYER, TRENCH FILLER

Only six men are required to operate this new German machine which first digs a trench, then lays the cable and finally fills the trench with soil—all in one operation as the monster moves along. It will be noted that the cable truck brings up the rear, the cable being carried forward along the arm to a point in front of the soil dumping tube. The machine at the left digs the trench and tows the truck

Problems of Solar Research

Many Perplexing Puzzles Have Given Way to Astrophysical Research, but Enough Remain to Keep Astrophysicists Occupied

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mt. Wilson Observatory of the Carnegie Institution of Washington

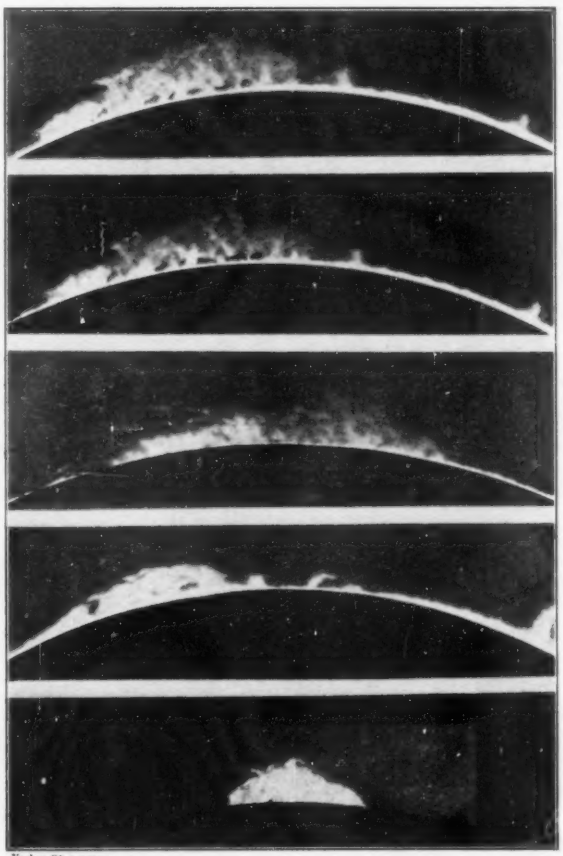
THE great luminous clouds which extend high above the surface of the Sun have been known for a century or so. They were first observed as brilliant scarlet specks at the edge of the dark Moon during a total eclipse. A little later measures were made which show that the Moon, as it moved across the face of the Sun, moved across these bright objects too, hiding some and uncovering others and making it evident that they were attached to the Sun and not to the Moon—whence arose the old-fashioned name of "solar protuberances," now altered to "solar prominences."

While study of these prominences was restricted to the few minutes of an occasional eclipse progress was slow, but sixty years ago Janssen and Lockyer proved that they were masses of luminous gas and that by isolating with a suitable spectroscope the particular kinds of light which they gave out strongly, they could be observed any clear day independent of an eclipse.

IT was then soon found that the prominences rise from a continuous layer of gas thousands of miles deep and called the chromosphere, which envelopes the whole surface of the Sun. Most of them are of a quiescent type, retaining their general shape and size for days and occasionally for many weeks; but some are evidently eruptive and change with extraordinary rapidity, moving at speeds which sometimes exceed 100 miles per second.

The invention of the spectroheliograph in 1890 by Hale and Deslandres made it possible to obtain admirable photographs of the prominences, giving a permanent record of their forms and motions, and a great wealth of facts is now available for the investigation. The interpretation of these facts is not always easy. The spectral lines show that the principal constituents of the quiescent prominences are hydrogen, helium and—calcium. The first two are light gases and might be expected in the upper parts of the Sun's atmosphere; but why should calcium, which is a metal with rather heavy atoms, accompany them when other metals were apparently absent?

Further puzzles appeared. What forces caused the extraordinarily rapid motions of these explosive prominences? Why do these forces sometimes work, not vertically away from the Sun, but sideways, as is clearly shown by observed lateral motions of bright knots in some prominences?



Yerkes Observatory

CHANGES IN A SOLAR PROMINENCE

The great "banyan tree" prominence of 1910 lasted from March 17 to April 28. The five spectroheliograms show its evolution

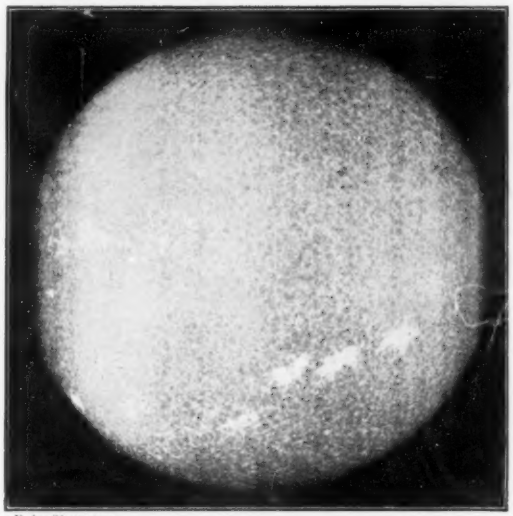
Strange as the eruptive prominences are, the quiescent ones are in some ways stranger. The force of gravity near the Sun's surface is very great. An unsupported body would fall 450 feet in the first second, 300 miles within a minute, and 280,000 miles in half an hour. Yet the prominences remain in position without visible means of support for days. What holds them up?

Finally, the chromosphere itself is a puzzle. Under such a powerful force of gravity the upper layers of gas should compress the lower by their weight. The simple calculation shows that even for the lightest gas, hydrogen, and for the high temperature of about 5000 degrees, Centigrade, which prevails above the Sun's surface, the density of the gas should double for a vertical descent of 100 miles, double again in the next hundred, and so on. The transition from gas as rarefied as to be practically indistinguishable from a vacuum, to gas so dense as to be opaque, should take place in a depth of a couple of thousand miles at most; for heavier gases, in a hundred miles or so. Yet the observations show that the chromosphere is six or eight thousand miles deep and that it does not appear to be much denser at the bottom than at the top.

IT is again evident that some force must be at work to hold the chromosphere up. What is this mysterious power that counteracts and sometimes overcomes the Sun's mighty attraction—that can hold up heavy atoms as well as light ones and push them sidewise as well as upward? The answer is now certain; it is the vast flood of radiation—light and heat—which escapes from the solar surface.

A body upon which light falls experiences a force—radiation pressure — which tends to drive it in the direction in which the light was moving. For light of moderate intensity such as sunlight at the earth's distance, this force is small and influences only very small dust particles such as probably occur in the tails of comets. Nearer the Sun both radiation pressure and gravity increase, but in the same ratio, so that again only small particles are affected.

Atoms are so small that the light



Yerkes Observatory

BRILLIANT CALCIUM FLOCCULI

These are great clouds of luminous calcium vapor in the atmosphere of the Sun, far larger than the earth

waves would go past them without disturbing them, were it not that the atoms themselves can absorb light. Light of the particular kinds which the atom can deal with will be absorbed and bear a powerful influence upon the atom. If, then, an atom near the Sun in its upper atmosphere absorbs light within the range of wavelength which the Sun gives off powerfully it will be subject to radiation pressure which may weaken the effects of gravity or even overpower them.

Now atoms of calcium (in the ionized state with an electron gone, in which they are pretty sure to be in hot rarefied upper layers of the solar atmosphere) absorb very strongly in a region where the Sun's radiation is itself strong, producing the great *H* and *K* lines in the violet.

Calculations by Milne have shown that such atoms, if exposed to the full intensity of sunlight undiminished by the weakening which occurs in these lines, would be powerfully repelled from the Sun and fly off at a great speed into space. As a matter of fact, these absorption lines produced in a lower atmosphere by calcium atoms which are entangled among a host of other atoms of all sorts and cannot escape, automatically adjust themselves to just such intensity that the remaining residual radiation almost exactly suffices to balance gravity. The heavy calcium atoms are thus held up in almost perfect balance and the depth of the chromosphere and the great height of the prominences are explained.

IF once a calcium atom, or a cloud of them, got started upward, things would change. On account of their motion they would no longer absorb radiation corresponding to the middle of the line in the solar spectrum, but to a wavelength on the violet edge of the line where it is not so dark. Radiation pressure would now overbalance gravity and the atoms would be urged upward at an ever-increasing rate. This process may seem to account in a general way for the upward acceleration exhibited by the great detached masses of the eruptive prominences, although many details of the observations remain puzzling.

Finally, the lateral motions of some jets and spikes of prominence material have recently been very ingeniously explained by a young Englishman, Mr. Pike. Observations show that the material in these jets is apparently attracted toward sun spots and even sucked into them at speeds which may reach 50 miles per second, while there are other regions from which the gas appears to be ejected and repulsed. Mr. Pike suggests that these repelling regions are faculae—the occasional bright areas surpassing in brilliance the rest of the photosphere. Such regions would exist in unusually strong radiation pressure, and drive the prominence forming gases away from them at an ever-increasing rate, the spots being cooler and darker than the rest of the surface.

IF the spot were not there the horizontal portions arising from all parts of the Sun's uniformly luminous surface would balance one another. If a spot should suddenly appear, the diminution of radiation pressure away from it while that in all other direction was unaltered, would lead to an apparent attraction.

Gas about a spot, too, would not be held up strongly enough to balance the whole force of gravity, hence there would be a tendency for prominence material to move toward the spot, both laterally and downward. Detailed calculations show that velocities as high as 50 or 60 miles per second may be reached under the combined influence of the repulsion of a facula and the "attraction" of a spot, and that the path of a moving mass of gas would be of very much the shape which is observed.

Great progress has therefore been made in interpreting the strange and at first sight inexplicable behavior of the prominences, but there is much that remains to be done.

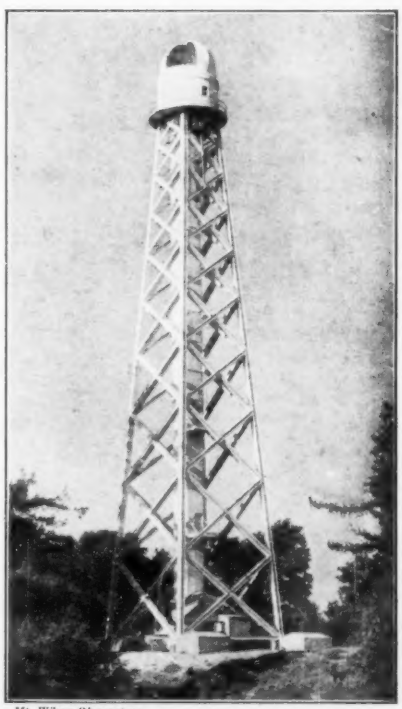
We can explain the absence of most of the other abundant metals from the prominences. At this very low density their atoms would doubtless be ionized. Now very few ionized atoms have their strongest lines in the region of the spectrum which is observable in the Sun. Those which do—strontium, titanium and even the very rare metal scandium—show up in the chromosphere and prominences. Others, like iron, have lines farther in the ultra-violet where the Sun's radiation is relatively weak and may be insufficient to hold up heavy atoms. For other atoms, such as sodium, the corresponding lines are still farther out and there is no hope of their being supported.

But the behavior of hydrogen and helium remains a puzzle.

THESE atoms are so hard to ionize that we need not consider its complications, but their strongest lines are so very far in the ultra-violet that they do not come in to the reckoning at all. The visible hydrogen lines must do a great deal toward keeping the hydrogen atoms afloat in space but the helium lines do not show an absorption at all, although they are strong in the chromosphere and prominences. Here is one of the puzzles which is not yet solved.

The astrophysicist is in no present danger of weeping because he has no more worlds to conquer.

¶ *Can we go to Mars? Writers of scientific fiction have played with this idea for decades and given it a bad name. Next month we shall tell of some serious thinking on the problem which, while far from solution, is no longer a dream.*



Mt. Wilson Observatory

THE SNOW TELESCOPE

Two mirrors atop the tower reflect the Sun's image downward into a deep well

Man's *First* Mechanical Achievement

Ancient Man's Stone Implements Passed Through a Definite Evolution

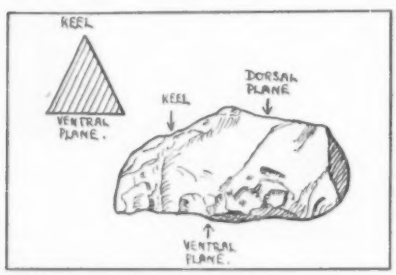
By J. REID MOIR
Fellow of the Royal Anthropological Institute of Great Britain and Ireland
With drawings by the author

BONE BED BENEATH THE RED CRAG

Figure 1: *The author is pointing to the bone bed in which many implements of the rostro-carinate type were found*

THERE are very few people, it may be supposed, who, after making an examination of the flint hand-axes of paleolithic man, and realizing the skill with which they were made, are prepared to believe that such highly-developed specimens represent the first efforts of an intelligent being to shape stone intentionally. The truth of this supposition was borne in upon me many years ago, and, in consequence, I set about searching for flint implements which could be regarded as the ancestral forms from which the hand-axes were developed.

At that time I had already carried out extensive researches in the bone bed, (Figure 1,) beneath the Red Crag of East Anglia, in the eastern part of England, and had recovered from this deposit a series of implements of definitely human origin, and referable to the remote Pliocene epoch. The most outstanding type of these pre-Crag specimens is one which has usually the unflaked flint cortex at one end where it was no doubt held in the hand, while the other is carefully trimmed to the shape of the beak of a bird of prey (Figure 2). These are the rostro-carinate implements which represent a new and hitherto unrecognized form of the handiwork of ancient man.



A ROSTRO-CARINATE

Figure 2: *Even before Pleistocene time, probably 1,000,000 years ago, this peculiar type of implement had already been evolved*

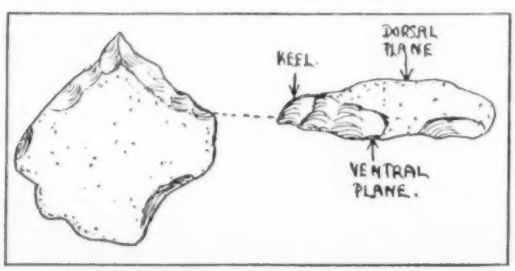
Now when these specimens were discovered I decided to ascertain, by making an examination of their flakings, exactly how and on what plan they were made, and this work revealed a very interesting and significant series of facts.

The earliest known implements of man are the eoliths which are formed almost exclusively from pieces of tabular flint which have been roughly flaked along one or other of their edges (Figure 3). In the days when these specimens were made there were available upon the land surface large quantities of tabular flint which possessed two naturally-produced and more or less flat striking platforms upon which the people of the Dawn Age could deliver blows with their hammerstones, and detach the discord flakes.

IT is somewhat difficult to imagine how these first representatives of the human race could ever have started making stone implements, but for the kindly provision by Providence of such easily-flaked material as tabular flint. However, the inventive genius of man, which is apparent even in Eolithic times, would probably have produced implements of some kind, even if tabular flint had not been available. It is not too much to say, however, that if this material had been absent the evolution of flint implements would have taken a different course from that which it followed, resulting in the development of implemental forms differing widely from those with which we are familiar. If a pointed eolith (Figure 3) is examined in profile it is seen that, in the majority of cases, a beak-like form is observable. The production of this form is, however, almost inevitable in making an Eolithic implement of pointed type, as may readily be proved by experiment.

When the first stage of man's evolutionary progress in implement-making had passed, we enter upon the next stage which is represented by the artifacts found in the bone bed beneath the Red Crag of East Anglia. When the people of these far-distant days arrived upon the ancient land surface of East Anglia they found that the flint at hand was in the form of rounded nodules, quite different from the tabular variety. We can imagine that these nodules were gravely examined by the new arrivals, and that attempts were made to detach flakes by delivering blows upon the rounded surfaces of the flints. The uselessness of these attempts would soon be made manifest, and the conclusion would be arrived at that some other method of attack was needful.

It was then that the knowledge acquired in Eolithic times came to their aid, and enabled them to see that by some means the intractable nodular flints had to be altered to a tabular form. In the last issue of this journal I have shown how this alteration was brought about, and it is therefore sufficient to say that the rounded stones were fractured by two cleaving blows by means of which a tabular piece of flint was produced. When this was accomplished, blows were delivered upon one of the flattish surfaces in the same way in which the Eolithic implements of pointed form were made, except that in the case of the pre-Crag specimens, the tabular flint, being of

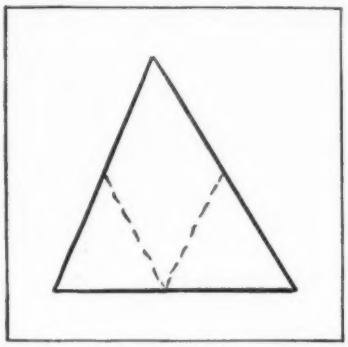


AN EOLITH

Figure 3: *Most ancient are the eoliths which blend into the dimness of Tertiary times, over a million years ago*

greater thickness, a large and more imposing artifact resulted.

In the rostro-carinate (Figure 2) most of one of the flat surfaces originally produced is preserved and is called the lower or ventral plane, while the other flat surface (the upper or dorsal plane) is considerably reduced in size in the formation of the pointed end and "keel" of the specimen. Now,



ANOTHER STEP FORWARD

Figure 4: *How the rostro-carinate type was converted to later type; a cross-section*

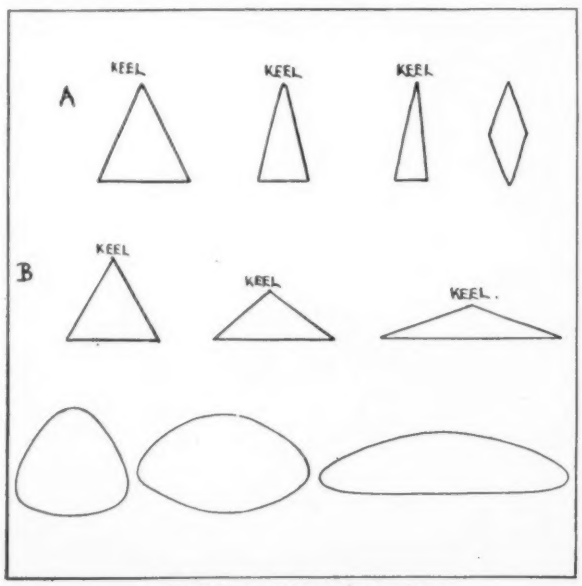
at first sight a rostro-carinate, of which a section taken through the functional portion is triangular, seems to bear no resemblance to a pointed or oval implement of lower Paleolithic age, which is generally of a rhomboidal section (Figure 4).

But fortunately there are preserved in certain collections, examples of the earliest Chellean hand-axes, and an examination I carried out of these soon showed me that some, when viewed in profile, with the pointed end held to the right or the left as the case may be, exhibit a definite beak-like appearance (Figure 5). Further, several of these specimens possess only one cutting edge, the other being represented by a flattish surface, while in the case of the side with a cutting edge there is often preserved a part of a similar surface (Figure 5).

These flat areas had been recognized by archeologists for some years, and described as "lateral platforms," which is a correct term when the specimen is viewed in the normal manner with the point uppermost. But the true significance of these platforms was not understood. Now, however, we recognize them to be the remains of the original striking platforms produced in the initial shaping of the nodule of flint, and precisely similar to those forms in the first stages of the manufacture of a rostro-carinate.

FROM the evidence of the various specimens of early Paleolithic implements now available for examination, it is clear that the keel of the rostro-carinate was gradually extended backwards until it extended from one end of the implement to the other, and gave to the tool the form of a chopper. When this was accomplished the specimen still retained its original triangular section, the base of the triangle representing the flattish surface held in the hand while the apex represented the cutting edge.

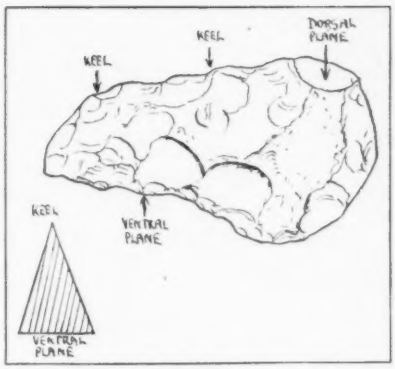
Apparently it was eventually realized by the ancient people that it would be an advantage if a cutting edge opposite to the keel could be produced, and after many attempts this was carried out by flaking away either side of the flat ventral plane (Figure 4). Thus the transition from a rostro-carinate with a triangular section to an early Chellean hand-axe with a rhomboidal section was accomplished by the *compression*, as it were, of the former until the new type of implement was produced (Figure 6).



THE COMPLETE EVOLUTION

Figure 6: *The lower figures, by the American Museum of Natural History, are sections of a spring dog fish, monk fish and skate*

Strange to say the type of paleolithic implement with triangular section of very low elevation which was formed by the *depression* of the rostro-carinate follows the plan upon which the fish known as the skate was evolved from ancestral squaloid form (Figure 6B). It is not of course to be supposed that the ancient flint flakers knew anything about the manner in which these fishes were developed, but nevertheless the facts above described are of considerable interest and possible importance.



EARMARKS OF TRANSITION

Figure 5: *Often these bear evidence of the evolution suggested by Figure 4*

In the paleoliths with a triangular section of low elevation the keel of the rostro-carinate had ceased to be a functional part of the implement, and these specimens thus differ markedly from those with a rhomboidal section —although the completed weapons could be put to precisely similar purposes.

FROM the above considerations it is obvious that the primitive eolith was developed into the rostro-carinate, while the latter gradually "evolved" into the well-known implements of Paleolithic type. The Eolithic specimens thus take their place at the very base of the implemental series and must therefore be regarded as having played a fundamentally important part in the development of human industries in pre-historic times.

Further, throughout all the various stages of flint implement making, Eolithic forms are occasionally found, as are the rostro-carinates; and I have in my possession examples of these primitive types found in deposits referable to the very end of the Stone Age.

There is no doubt that any implement which survived and was used over a period of at least 500,000 years must have been of great importance to prehistoric man. After many years experience and intensive assimilation of flint implements of all ages I have reached the definite conclusion that every ancient industry is indissolubly linked to that which goes before and to that which follows after it, and that all can be traced back in an unbroken line through the rostro-carinate implements to the primitive and simple eoliths which represent, so far as we at present know, man's first mechanical achievement.

¶ *This completes the series of three articles on flint flaking. Readers are requested to send the editor samples of their efforts to reproduce the ancestral skill.*

A NEW FARM PRODUCT

The fur of muskrats, now raised on farms, is much sought after for use in so-called "Hudson seal" and other coats

Muskrats *to* Order

The Fur of These Once Lowly Rodents Now Forms the Basis of Profitable Farming Projects

By E. L. CHICANOT

IT is not long since the muskrat in Canada was regarded as a very insignificant member of the country's fur-bearing fauna. His value was almost too trivial for the northern trappers to bother with him, unless the pelts could be secured in large numbers without any great effort. Farm boys used to make good use of their spare time by trapping or shooting muskrats along streams or the edge of sloughs in the neighborhood of their homes and then taking the pelts to town on Saturdays to be traded in at the general store for a handful of candy. Times have changed. Today the same unprepossessing little rodent is occupying the attention of brainy men with capital and initiative, and the stretches of swamp and marsh, heedlessly passed over in the years of agricultural settlement as utterly unfit for any practical purpose, have taken on a high value as suited to the domestic rearing of muskrats.

ONE of the outstanding and most interesting features of post-war development in Canada has been the expansion and branching out of the Dominion's fur-farming industry. The vast amount of valuable information acquired in the gradual evolution of the fox-farming industry, which has spread from Prince Edward Island into every part of Canada, and from the Dominion into nearly every country of the globe, has been applied with most gratifying success to the domestic rearing of other fur-bearing animals whose pelts are in continual demand, both indigenous and exotic. Each year new ramifications have been added to the fur-farming industry until it now includes, in addition to foxes of all kinds, raccoon, mink, skunk, marten, fisher, lynx, beaver, coyote, Siberian hare, Chinchilla rabbit, and Karakul sheep.

The Canadian Government, which first took official cognizance of the fur-farming industry of the country in 1919, has been able, in a fairly accurate manner, to keep track of and record the progress of all branches of this new activity with the exception of muskrat ranching. Owing to the manner in which establishments devoted to the raising of this animal are operated, approximating the natural, primitive condition, the securing of statistics has been found impossible since operators themselves have but the vaguest of ideas as to the extent of their possessions. This is one reason why the astonishing growth which has taken place in muskrat ranching in Canada has not received the attention it warrants and why the significance of certain developments in western Canada at the present time are not properly appreciated.

From the earliest days when men were attracted to the forbidding land fabled to contain rich peltry, the humble little muskrat has played an outstanding part in the country's fur trade. Down through the years when Canada was considered little else but a large fur depository, and later through the stages of agricultural settlement, it has been trapped in hundreds of thousands annually. While the beaver may have accounted for the greatest revenue, his humble relative has contributed the numbers. Records of the Hudson's Bay Company show that in 1850, 175,000 Canadian muskrat skins were sold in London; in 1860, 250,000; in 1870, approximately the same figure; and by 1902, 1,650,000. Government figures show that in the season 1922-23 nearly 4,000,000 muskrat pelts were taken in Canada; in 1923-24, 3,000,000; and in 1924-25 over 2,500,000.

Quite meteorically this ubiquitous and plebeian little rodent has made an ascendancy into the ranks of the aristocracy. From the most insignificantly regarded of the country's fauna he has come to be one of the most appreciated and valued by trappers, traders, and manufacturers alike. The initial ambitious step was made in the concluding years of the first decade of the century when this lowly slough-dweller began to achieve a marked popularity under the pseudonym of Hudson seal. Gradually it came to take on many other aliases, and the security of the future of the muskrat industry is held to be the readiness with which the pelt of the little animal can be adapted to imitate the rarer and more valuable peltry.

THERE has naturally been a corresponding rise in the revenue accruing from the sale of muskrat pelts. In 1850 Canadian muskrat skins sold in London for eight cents apiece, and in 1860 for 19 cents. By 1903 the price jumped to 22 cents, and in 1910, when the upstart ambitions of the humble-born rodent were first evidencing themselves, pelts brought an aver-

DOWN ON THE FARM

A pair of contented muskrats on the edge of a pool on the marshy land which is their farm home in Nova Scotia. Their pelts will soon be part of a "near seal" or other fancifully named coat

age of 87 cents. From then on the muskrat continued to realize good prices until in 1919-20, a year of extraordinary values in all lines, the spectacular figure of $10.50 was reached at the New York fur sales. Prices have now become fairly stabilized under steady demand and there is every likelihood of their remaining so. The Canadian catch of 1922-23 returned an average of $1.32 per pelt to the primary producer; that of 1923-24 $1.15; and that of 1924-25 $1.11. At the Montreal fur sales in 1925 muskrat pelts sold up to two dollars and in 1926 and 1927 ranged from $1.50 up to two dollars, prime ranch-bred skins bringing a slightly higher figure.

THE rising value of peltry, in combination with the devotion of interest to the matter of expanding the fur-farming industry, resulted in some attention being given in parts of Canada to the possibilities of raising muskrats domestically, which it seems almost strange now should not have come earlier. Immediately there was inaugurated an industry of such tremendous possibilities, with so many advantages and such opportunities for profit, and withal so few apparent handicaps, as to cause conservative individuals to hesitate at the very rosiness of the prospect. And, according to the best authorities, conditions are exactly what they appear to be. Domestic muskrat rearing they declare to entail little labor, to be remunerative, and at the same time to be practically fool proof. While Canada has no monopoly of the industry, which is to be found flourishing in many parts of the United States, it promises to attain heights of development in the Dominion which no other country can reach because none other possesses all the requisites to such a degree.

While experiments in raising muskrats without water, in small pens, on dry land, after the intensive manner of foxes and other valuable fur-bearers, have been successful, without injury to the fur or the health of the animal, and without impairing the prolific breeding qualities of the animal, such methods would appear to be objectless and impracticable, and have received little attention. With the relatively low value of the individual pelt, the essence of muskrat ranching is production on a large scale, and Canada is dotted in every section of her wide expanse with pieces of waste, unproductive swamp and marshland, the natural home and breeding ground of the little rodent.

To transform such a piece of swamp into a muskrat farm is the easiest thing imaginable, and when effected on a large enough scale the animals scarcely realize they are being confined or "farmed." All that is required is a rat-proof fence put around the entire acreage and sunk to a depth of about eight inches in the ground. This is not so much to keep the rodents from wandering too far as to prevent the coyote and fisher, the natural and almost only enemies of the muskrat, from getting in.

SUCH a piece of land in Canada will almost invariably be found to contain the nucleus of the future rat population and continual stocking may be effected from neighboring creeks and sloughs to supplement the foundation colony. Muskrats can be caught in box traps at any time of the year, and the extent of operations is only limited by the area fenced.

Thereafter there is not a great deal to do but watch the animals multiply and take toll of the increase in the winter. The muskrat is extremely prolific, with from three to five litters per year, and a pair of animals will produce as many as 50 young in a season. A 500 percent increase in a ranch's population in a year is a very conservative estimate. Muskrats are signally immune from disease, and the greater part of their sustenance is naturally provided both winter and summer. A shortage of natural food in the winter months is met by vegetables thrown through a hole in the ice, the icy water keeping the vegetables indefinitely. The economy of feeding may be gathered from the fact that a bushel of turnips or mangels will feed a muskrat from 10 to 12 weeks.

A FUR FARMER

This successful muskrat farmer made a profit of 10,000 dollars for a year's catch

IT is little wonder that such numbers of people in all parts of the world have been investigating the possibilities of the muskrat industry in Canada. It is considered that the time may come when the domestic raising of this little rodent will generally be added to the many phases of mixed farming followed in Canada, and agriculturists utilize pieces of unproductive swamp land on their holdings to develop a profitable side line, as is becoming an increasing practice with foxes, to supplement farm revenue. There are already a great many farmers in all parts of the Dominion raising muskrats on small sections, although the present conception of muskrat ranching is an elaborate enterprise involving a substantial acreage and the production of the animals by the thousands each year. For this purpose large sections of what was previously considered waste land are being taken up and the development of a gigantic industry is forecast, particularly in the western part of the Dominion of Canada.

A TYPICAL MUSKRAT MARSH

This is the kind of land which is ideal for muskrat farming. Low, marshy, it is of little or no value for other purposes, but is ideal for raising the valuable rodents as it is their natural haunt

The present extent of the muskrat industry in Canada is only vaguely known, although it is followed in every

THE FENCE

A wire fence keeps the rats in, and excludes their enemies, the coyote and the fisher

province, for establishment on the part of Canadians, Americans, and the nationals of other countries has been taking place quietly and unheralded. The elaborate movement under way, particularly in the western provinces, is only publicly indicated when some very large enterprise is launched. It only became known that the governments of the Prairie Provinces had been deluged with applications to file upon marshlands in the territory when the provincial authorities together approached the Dominion Government with a view to securing the transfer of the control of such lands to them. Shortly after this, Manitoba set about an official scientific survey of lands, food supply, et cetera, in its northern territory which possesses some of the largest marshes on the continent and put the airplane to novel use in sowing wild rice over these lands in order to extend the feeding grounds and natural habitat of the muskrat.

IN the last great pioneering territory of the Peace River country of northern Alberta, where many stretches of land suitable for muskrat ranching exist, there has been quite an invasion with this objective. Not long ago a syndicate acquired 15 quarter sections, or a total of 2400 acres, upon which there were thriving muskrat colonies, and transformed it, by fencing, into a gigantic muskrat preserve. Eastern capitalists secured 1000 acres of swamp at Oak Lake, Manitoba, for a similar project and the fencing of the property alone cost 20,000 dollars. A Milwaukee cattle rancher, establishing a large Hereford ranch in Manitoba, purchased an adjoining 640 acres of swamp, stocked it with muskrats, and formed a syndicate to operate it.

Yet greater interest and activity has been apparent in British Columbia, where the muskrat, domestically reared, supplementing the raw catch, reaching the market as Hudson seal, has almost in point of value come to take the place of the great annual catch of seal skins in the North Pacific which constituted such an important item of British Columbia revenue in the past and was brought to an end some years ago by international treaty. The growth of the industry there is by no means solely attributable to residents of the province but to many newcomers from Washington, Oregon, and other Pacific coast states.

In this province the Columbia-Kootenay valley has come very much to the fore in the muskrat industry. The confluence of two great rivers, it possesses tremendous areas of overflown marshlands, the haunts of muskrats, and these have been fenced off and occupied with a rapidity which forcasts a great local industry. Not only have old residents of the valley turned to this new activity but last year ranches of over 1000 acres in ex-

A MUSKRAT HOME

Composed of mud and sticks, the rodents' homes dot the swamp of the muskrat farm

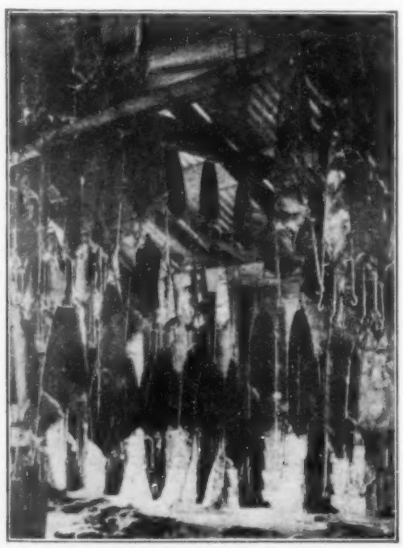
tent were established by men who had come from Washington and Oregon for the purpose.

The same is taking place in other sections of British Columbia's interior where large areas of such suitable land are frequently to be found, and men who have been following the arduous trap line for years are coming to settle down to an equally profitable living under the more comfortable conditions of intensive farms. The biggest muskrat ranch in Canada, which probably means the entire world, was established not long ago at Swan Lake, about 40 miles west of Quesnel, in central British Columbia. It consists of an area of swampland, lake and woods, totalling over 8000 acres. Some idea of the extent of operations may be gathered from the fact that weekly disbursements to trappers for foundation stock ran to a thousand dollars, and it is calculated that the ranch, when in full swing, will have an annual output of about 50,000 pelts.

The greatest development in muskrat farming in western Canada is yet to come. The petition of the Prairie Provinces to the Dominion Government was granted and they have secured control of their swamplands to be leased for the purpose of following this activity. Leases are ordinarily not to exceed 640 acres, although larger leases may be secured if conditions are such as to warrant granting them. A yearly rental of 25 cents per acre is to be charged for the first three years, thereafter one dollar per acre. Trapping of muskrats will not be permitted during the first year of any lease except under special permit. Awaiting the coming into force of these regulations are over 200 applications in Alberta, over 500 in Saskatchewan, and over 250 in Manitoba. The present year should see the real dawning of the muskrat era in western Canada.

MUSKRAT farming in western Canada, there is every indication, is going to be a great industry. It is a phase of the broad and growing industry of fur farming which has just been initiated and already gives definite promise of outstripping other branches of domestic fur production in popularity and possibly in revenue. It is an industry which has a particularly strong appeal for the uninitiated contemplating engagement in fur farming, since in it expert and novice have practically equal chances, and this is going to be a factor in swelling the army of followers. It is of peculiar value and outstanding benefit to the country as utilizing and rendering revenue-producing such spaces as are at present unproductive and considered worthless.

¶ *Zane Grey, well-known author and sportsman, has prepared a thrilling story of big game fishing in the South Seas which will appear shortly.*



MUSKRAT WAREHOUSE

After removal, the rat pelts are stretched on special wire forms and hung up to dry

How Old Are The Everlasting Hills?

Dating the Geologic Age of Mountain Ranges Involves a Careful Investigation of Many Kinds of Evidence

By EDWARD W. BERRY

Professor of Paleontology, Johns Hopkins University; Geologist, United States Geological Survey; Assistant State Geologist, Maryland; Member, National Academy of Sciences; American Philosophical Society

MOUNTAINS, like shore lines, seem to be the permanent features of geography, and doubtless from the standpoint of marking political boundaries they are most admirable. But from the standpoint of geology both are temporary features of the autobiography of the earth.

Mountains were the very last features in man's environment to be humanized, as it were. We can only surmise what early man thought, but judging from the reactions of present-day, backward or savage races such as the Andean Indian, the mountains were the abode of spirits—mostly hostile, as suggested by the inhospitality and terrors of the high peaks.

We get the same impression from Greek mythology or from a perusal of English poetical or prose writings to the end of the 18th Century. Mountain scenery was to be viewed from a distance. The high regions of the earth, rugged, desolate, and dangerous, were not to be trifled with nor entered lightly, nor traversed save under direst necessity. This, as I have hinted, was due largely to the unconscious survival of notions inherited from earlier days when the mountains were the abode of evil spirits, and was not a mere prejudice, as Geikie calls it.

AMONG the host of mountain climbers that annually go to the Alps, the Rockies or the less lofty White Mountains, or those that brave the Canadian Rockies, Andes or Himalayas, how few are aware that these majestic features of the earth's surface are so youthful, or that even the Alps—that great playground of mountaineering, which has in recent years been the inspiration of an entirely new school of mountain structures—was scientifically unknown until first studied by the geologist de Saussure, born in Geneva as late as 1740?

The geologic history of mountains may be said to have been inaugurated by elongated depressions in the earth's crust sufficient to permit the flooding of the region by oceanic waters. Then, through long ages sediments accumulated in these geosynclines, as they are techinally termed. With the gradual sinking of their foundations these sediments—mostly sandstones, mudstones and limestones—piled up thicknesses of many thousands of feet. At intervals these sedimentary beds were folded by compressive crustal forces. It was formerly supposed that this folding of the rocks resulted in their elevation, but this is now known in many instances to be a false assumption, for the elevation to great heights usually occurs ages after the rocks were folded, and is due to gravitational readjustments, the folded sediments being of less density than the enclosing plutonic basin.

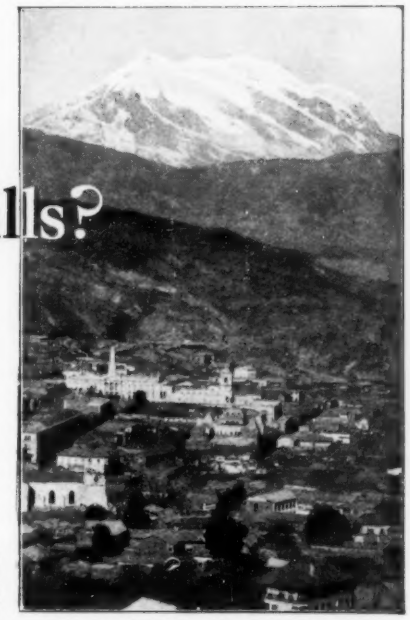
THE GEOLOGICAL TIME TABLE
1.0=One million years

ERAS	PERIODS	TIME SCALE (After Barrell) Minimum	Maximum	CHARACTERISTIC LIFE
PSYCHOZOIC	Recent	1	1.5	AGE OF MAN
	Pleistocene			
	Pliocene	7	9	AGE OF MAMMALS AND MODERN FLOWERING PLANTS
CENOZOIC	Miocene	19	23	
	Oligocene	36	39	
	Eocene	55	65	
	Cretaceous	95	115	AGE OF REPTILES
MESOZOIC	Comanchian	120	150	
	Jurassic	155	195	
	Triassic	190	240	
	Permian	215	280	AGE OF AMPHIBIANS AND ANCIENT FLORAS
	Pennsylvanian	250	330	
	Mississippian	300	370	AGE OF FISHES
PALEOZOIC	Devonian	350	420	
	Silurian	390	460	AGE OF HIGHER SHELLED INVERTEBRATES
	Ordovician	430	490	
	Cambrian	600	700	
PROTEROZOIC	Systematic classification variable	925		AGE OF PRIMITIVE INVERTEBRATES
		LONG EROSIONAL INTERVAL		
ARCHEOZOIC		1500		DAWN OF UNICELLULAR LIFE, ALGAL FORMS REPORTED

Courtesy of Field Museum

BARRELL'S TIME ESTIMATES

The durations are based on radio-active changes in rocks of the several time periods



ILLIMANI AND LA PAZ

This great mass, 21,204 feet in altitude, consists largely of Tertiary granite laid bare by erosion in the uplift of the eastern Andes

Elevation alone would scarcely develop mountains as we know them, but rather plateaus, and it requires the long continued action of the weather—snow, rain, frost, and so on, to remove the more soluble and less resistant portions and etch the relief of peaks, valleys and crags that are the distinctive features and charms of all mountain ranges.

It may be said then that, granting the appropriate antecedent history as outlined above, the two immediate factors concerned with mountain building are elevation and subsequent erosion. A surpassingly interesting problem is that of dating the elevation.

WE know that all of the great mountain ranges of the present were elevated in comparatively recent geological times, since long continued erosion finally reduces the inequalities of the topography and wears them down to their roots, like the present Piedmont country which forms the inland border of the Atlantic Coastal Plain.

It is comparatively easy to date the time of the folding of the sedimentary rocks by the fossils which they contain, but this is not to be confused with the period of uplift, and the last is much more difficult, largely because it is comparatively rare to find marine fossils after uplift commences. If we find, as is the case, marine fossils of Pliocene age at heights of a mile in the southern Andes, we know of a certainty that there has been an elevation of over 5000 feet since the time they lived.

But elevation does not proceed at a rate that can be called rapid from the human point of view, and hence the rising mountain area will usually have been above sea level for many thousands of years before it reaches its maximum height. The sedimentary rocks that are formed during this period of uplift will be volcanic ash, lake and stream deposits and will doubtless contain some traces of the contemporaneous terrestrial animals and plants. But in most cases, although we can tell the age of these fossil terrestrial organisms with even more precision than we can tell the age of fossil marine organisms, we cannot tell the altitude at which they lived, and hence have no measure of the amount the beds containing their remains have been elevated since they were entombed.

GREAT SNOW MOUNTAIN

Here, in the Quimsa Cruz range of Bolivia, the author collected marine fossils in rocks thrust up above 16,000 feet in altitude

An illustration will make clear what I am trying to explain. At many points in the Great Basin of the western United States we find ash beds or clays and diatomaceous beds containing leaves and other traces of the contemporaneous vegetation. A notable locality of this sort is around Spokane in eastern Washington, and there are others in Idaho and Nevada. These fossil plants are like those found today in the mesophytic hardwood forests of the eastern United States and those of eastern Asia—such things as sassafras, tulip trees, gums, walnuts and magnolias.

WE know that they could not exist in the present more or less arid environment of the Great Basin. We know that during the Miocene age when they flourished, the climate was more humid than it is today in that region, and we know also that the main factor in bringing about the present day aridity was the elevation of the Sierra Nevada and other ranges.

We can conclude, then, that in late Miocene time this mountain chain was not yet sufficiently elevated to have brought about the extinction of the Miocene flora; but at what altitude that flora lived, or what the amount of post-Miocene elevation was, we have no means of determining at present.

A mountain system which has long attracted my attention as likely to throw light on our problem is the Andes. They are unique among the great systems of the earth in that they are now excessively and continuously high; they overhang a coast, and what is more to the point, they run approximately north and south, well across the equatorial and south temperate zones, and consequently intersect the two most constant wind systems of our planet—the easterly trades throughout their northern extent, and the westerly "roaring forties" throughout their southern extent, and both of these wind systems are better developed and more constant in the Southern Hemisphere than their counterparts in the Northern Hemisphere, since in the north the great extent of the continents seriously modifies and impairs their steadiness.

THE south temperate westerlies compose the strongest, deepest, and most constant wind system of the globe, and the southern trades come next. Ignoring the other factors, the rearing of the bulk of the Andes across the paths of these winds has resulted in profound climatic changes and equally profound changes in the character of the animal and plant inhabitants of the region. The eastern slopes of the Andes from southeastern Colombia through Ecuador and Peru to central Bolivia are among the wettest regions of the earth and are covered with a tangle of tropical verdure. The western slopes of the Andes from central Chile southward become progressively wetter until in the region around and south of Valdivia, Chile, we encounter another region of excessive rainfall and consequent equable temperature, resulting in a temperate rain forest rivalling that of the wet tropics.

A comparatively few miles across the mountains and the picture is entirely changed. From the Gulf of Guayaquil in Ecuador to Coquimbo in Chile, a distance of over 2000 miles, the west coast is desert and there are long distances where it may not normally rain at all for years at a stretch. Correspondingly, on the east side of the Andes from southern Bolivia to the Straits of Magellan is the rain shadow formed by the Andes in the path of the westerly winds, and a resulting practically treeless steppe and pampas country.

Obviously these present climatic and vegetational contrasts on the opposite sides of the Andes throughout so much of their extent were brought about by the elevation of the mountain mass, and these changes are rather clear cut and typical, although by no means as simple and devoid of local complexities and perplexities as I have sought to present them. It follows, then, that we have, in the Andean segment of South America, a region, if anywhere on the earth, where terrestrial fossils will help us solve the date and measure of uplift.

FORTUNATELY, fossil plants of Tertiary age are by no means rare and I have been engaged in the exciting pastime of hunting them down and studying them for many years. To date I know over a score of widely scattered localities ranging all the way from the shores of the Caribbean to Terra del Fuego, and many are most strategically situated. Some are in the Peruvian desert, others in the eastern foothills of the Peruvian Andes. A number are in Bolivia in the western Andes, on the high plateau and in the eastern Andes. Others are in the present wet coastal region of Chile and east of the mountains in Patagonia. Thus they not only prove that the equatorial trades and the temperate westerly winds were operative in the late Tertiary just as they are at the present time, but they furnish the most precise data that we have for estimating the rate and amount of uplift since Pliocene time.

MOUNT CACA ACA

Caca Aca, in Bolivia, is 20,571 feet in altitude. Here also, the author collected marine fossils above the 16,000 foot level

The detailed technical evidence would not interest the reader, but it may be said that one finds in the Peruvian desert the fossil remains of a wet tropical forest whose relatives are found today east of the Peruvian Andes. Similarly, in Patagonia one encounters fossil plants like those "found fossil" across the mountains in the south Chilean coal fields and whose near relatives occur at present in the Argentine mesopotamia or in the humid country in southwestern Brazil.

ON the famous peak of Potosi in Bolivia, in the volcanic ash deposits of a tiny Pliocene lake at a present altitude of about 13,000 feet, the fossil plants are those of a low country. On the bleak and treeless Bolivian plateau at elevations of 11,000 to 13,000 feet one encounters the leaves of lowland species and the petrified tree trunks of such woods as the Lauraceae and Leguminosae with no traces of seasonal rings, such as one finds today in only low and well watered warm regions. In the mountains near Cochabamba, Bolivia, and similarly near Celendin, Peru, are fossil plants of tropical rain forest types such as are found today only at altitudes from 3000 to 6000 feet lower and east of the mountains.

All of the facts thus far discovered consistently point to the same conclusions. We have the fossil seeds of bananas and other tropical fruits at altitudes much greater than they reach

HIGHEST PEAK IN PERU

Huascaran (22,051 feet). From a study of fossils of known age much may be deduced concerning mountain uplift

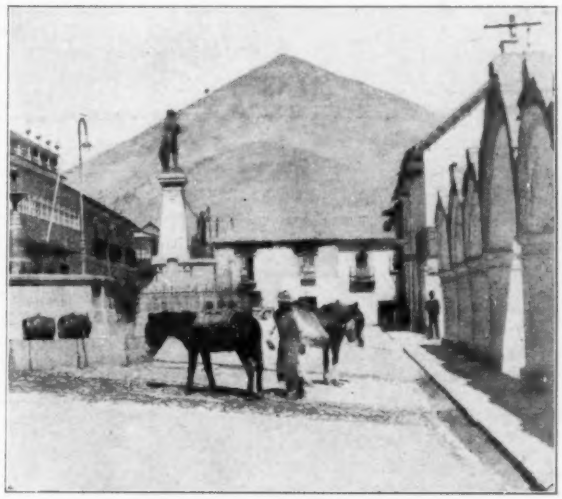
at the present time in the mountains bordering the sabana of Bogota on the east.

The fossils found at 11,800 feet in the present mountains of Cochabamba are especially impressive. Here, on a bleak and windswept pampa above the tree line, and clothed only with grasses, were found the relics of a rich tropical forest of palms, ferns, bananas, chiramoyas, and so on, which grew at heights which I estimated were from 6500 to 8500 feet below their present altitude.

No more dramatic or dynamic picture can be imagined than the final uplift of this majestic mountain system across the equatorial zone at the close of the Tertiary; and that this took place in comparatively recent times, geologically speaking, is shown by various collateral lines of evidence. Naturally, in the bordering country from Ecuador southward to Cape Horn where this uplift resulted in heavy rains on one side and relative to extreme aridity on the other, no comparisons of the existing faunas or floras on two sides can furnish much evidence. But in regions like the Choco country of western Colombia where wet tropical conditions continued uninterruptedly we find today many species of birds and fresh water fishes that have been isolated from their fellows of the upper Amazon and upper Orinoco country for a time too short to have them show any great differences; so that frequently you will find the same species, or at best merely a subspecies, dwelling in the coastal region of Colombia or northern Ecuador and separated from their kin of the country east of the Andes by hundreds of miles of mountain country with temperate, or at extreme heights, of boreal forms of life.

THE fossil remains of warm blooded animals in the late Tertiary deposits of the Andes tell the same tale as the fossil plants, although the details are not so well known. Still we know that at the time the plants that I have been speaking about were flourishing, the present mountain country was inhabited by large herbivorous mammals such as the mastodon, horse, and gigantic ground sloths. These would speedily starve to death if they could be re-introduced into the country over which they once roamed when it was at a lower altitude. Some of the elevations where these fossil mammals have been found may be of interest. Thus, La Casa del Diablo in Peru is 12,400 feet, Ayusbamba, Peru, is slightly higher, and a locality near Cerro de Pasco, Peru, is 13,000 feet, as is Ulloma, Bolivia.

Other corroborative lines of evidence of the recency of the last and major elevation of the Andean system are drawn from the uplifted marine terraces of Pleistocene age, especially well developed in Chile and northern Peru. Other data are derived from the evidence of tilting of old land surfaces once approximately horizontal (peneplains), or from a study of drainage profiles.



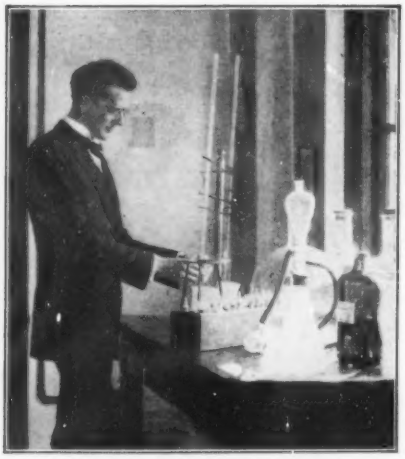
YIELDED FIVE BILLIONS

Cerro Rico de Potosi (15,381 feet) has yielded 5,000,000,000 dollars in silver. High up on its flanks are lowland plant fossils

Still other and more impressive are the maturely eroded upper slopes of the high mountains.

A PHYSIOGRAPHER, if he were put down in the midst of the mountains, would imagine from the waste-covered gentle slopes and the abundance of undrained *punos* or *paramos*, that he was a few hundred, instead of 14,000 to 16,000 feet above sea level. The Andean country of the lower slopes and the stream patterns are youthful instead of mature, showing the results of the rejuvenation of the streams brought about by the last and greatest uplift of the region.

That the final elevation of the Andes was also the approximate time of uplift of all of the present mountain systems of the earth seems to be a safe generalization, since, as I remarked at the beginning of this article, if they had been raised to heights much earlier they would have been reduced to insignificance by now, through the action of weathering and erosion. We believe this dictum, but no system shows it as clearly and conclusively as do the Andes. The accompanying superb views of famous peaks might seem to belie my statement of the mature topography of the upland, but they, like many others that might be mentioned, projected so much above the general level that their grandeur has been increased rather than decreased by the very processes which produced the Tertiary base level, and the active erosion during the Pleistocene following their final elevation has stripped much of the blanket of sedimentary beds from their flanks.



DR. GEORGE D. McLAUGHLIN

Dr. McLaughlin is director of the laboratory supported by the tanning industry

Unhairing Hides

Good Leather Now Made Faster By Discovery of How Lime Removes Hair From Prepared Hides

By ROBERT W. GRIFFITH

THE beautiful specimens of the leather worker's art that one sees in store windows bear little resemblance to the original raw material from which they were produced. Many interesting and almost mysterious things happen to leather between the time it leaves the animal as a hide and the moment a dealer puts the leather article on display.

Since the dawn of history, hides have been put through processes that convert them into what is essentially a different product. But even though these processes have been basically unchanged in a thousand years, men are still discovering new facts about what takes place. Recently, for example, the tanning industry has discovered exactly how it has been removing hair from hides all these centuries—and with the discovery it is preparing for industrial advances that will have their effect upon the shoes we wear, the luggage we carry and the leather we use in many other ways.

THE discovery, which has been made during recent scientific researches at a laboratory supported by the industry, has introduced a new factor in the production of the world's leather: methylamine. It now appears that methylamine, a product that results from the chemical action of lime on the hide epidermis, is the agent which actually releases hair from a hide. Having learned that, the tanner may now use methylamine in such a way that the important process of unhairing takes place in far less time than formerly. At the same time none of the benefits of lime action on the hide is lost. Fibers are not injured by the swifter depilation; the smooth silkiness of the grain surface is preserved; and all the advantages of the old process, in so far as quality of result is concerned, are retained.

There are few products of so permanent and lasting a nature as leather that originate in a material so apt to decay as raw hides and skins. Disintegration and decay begin at the moment hides are taken off the animal carcass and it is necessary that these be promptly arrested, and the hide and skin substance preserved so that the tanner may receive his raw material in a good condition. Fortunately the preservative process most commonly used is a simple one and relatively cheap, permitting shipment of raw hides and skins to all parts of the world. For this purpose they are first washed with water to eliminate dirt and blood and are then immersed in a solution of common salt. Afterwards solid salt is sprinkled over the "flesh" side and the hides are piled evenly one over the other.

In many cases, especially in the United States, the practice is to confine the process merely to washing the hides and sprinkling the salt on the flesh side. The hides are allowed to remain in piles or "packs" for varying periods but not less than 30 days, during which they are said to be "in cure." The hides are then rolled or folded into bundles separately, tied with string, and are ready for the market.

Hides properly cured or preserved may be kept in cool storage for a long period but they must not be allowed to heat in pile. If this happens, damage may occur which seriously affects the value of the leather.

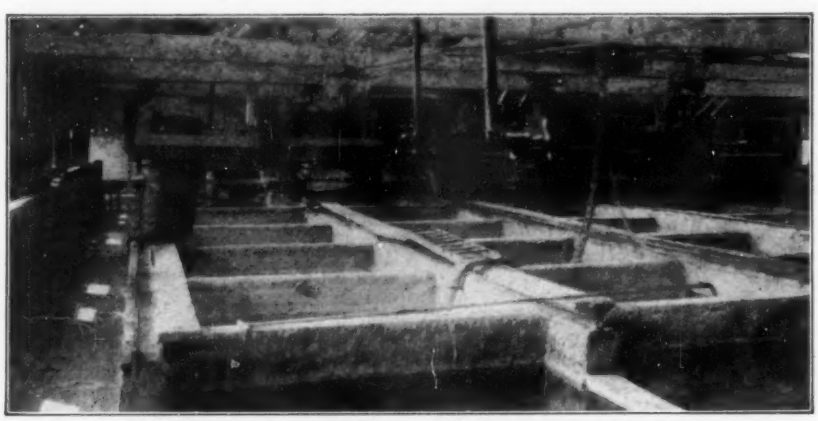
On arrival at the tannery, hides are sorted for quality and weight and are inspected for butcher cuts which have an important bearing on the value of the hides. They are also examined for grubs—embryo parasites which are hatched and developed in the hides after the death of the animal.

The first step in the tanning process is to bring the hide back to its original condition by removing the salt or other curing material. This is accomplished by soaking the hides in fresh water and is usually facilitated by mechanical means. The hides are then ready for the depilatory which is usually a mixture of lime and water of about the consistency of milk.

JUST how lime came into use for this purpose is not known and history does not record it.

It is, however, an ideal depilatory. Because of its limited solubility, it can be used in large excess without injuring the fibrous structure of the hide. Lime, or calcium hydrate, is alkaline in its action and its function is to remove the hair and swell the fibers for the subsequent tanning process. At ordinary temperatures the liming process takes from five to seven days but the time can be shortened by employing mechanical action at slightly higher temperatures.

In recent years, alkaline sulfides mixed with calcium hydrate have come into general use to facilitate the dipilation of the hide. Sodium sulfide is the material most frequently used, but because of its high solubility, care must

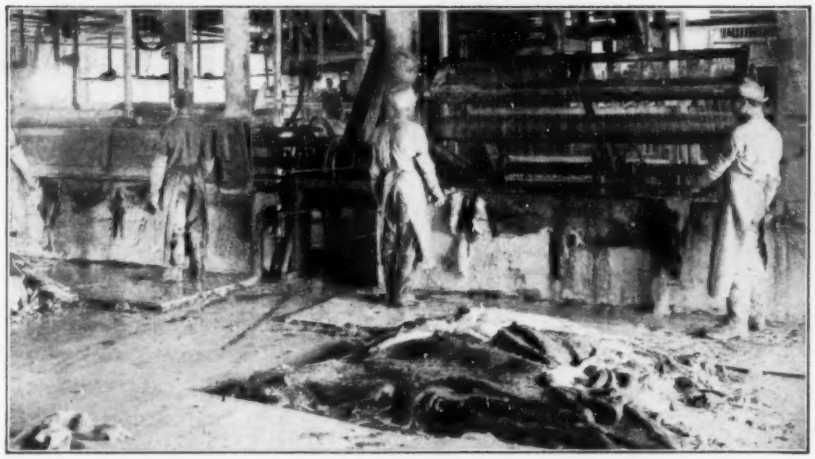


WHERE THE METHYLAMINES GET IN THEIR WORK

These huge liming tanks receive the hides after the salt used as a curing agent has been soaked out. The lime action loosens the hair, thanks to the intense activity of the busy methylamines

be taken in using it. Used in excess, it dissolves the commercially valuable hair. A great many new depilatories have been introduced from time to time but none have supplanted caustic lime for general use.

Until recent years, science had not given much attention to the problems of leather making and only within the past decade or two have chemists specialized in researches pertaining to leather manufacture. It is to the credit of the American leather industry that the first steps toward placing the industry on a scientific basis were taken by it. With funds contributed by the Tanners' Council of America, a modern, well-equipped laboratory was built at the University of Cincinnati under the direction of Professor George D. McLaughlin.



OFF COMES HAIR AND SURPLUS FLESH

After leaving the liming tanks the hides are put through a pair of scraping rolls such as are shown. The hair, loosened in the liming bath, is removed and the hides are ready for tanning

THIS laboratory, devoted exclusively to leather research, has functioned only a few years, yet has made remarkable progress in its attention to the fundamental problems of the tanning industry.

More than half of these problems are connected directly with the raw hide because the hide is the tanners' basic problem. The curing of hides by meat packers and butchers has received the closest attention and study by this laboratory with the result that the best means for curing hides for the preservation of the maximum leather forming substance has been demonstrated on a large commercial scale.

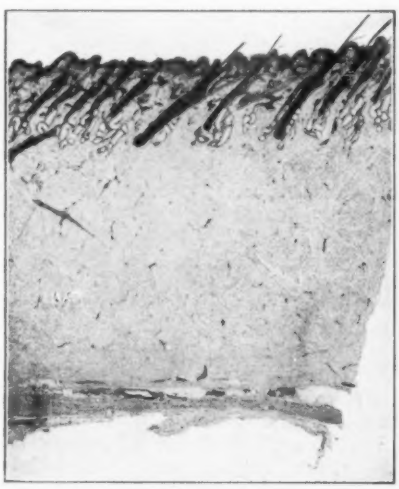
Following this accomplishment, the leather research laboratory under the guidance of Professor McLaughlin has devoted itself to the study of the action of lime on hides and skins and, after many months of painstaking effort, has finally arrived at what is believed to be the correct answer to the question: What causes the unhairing of hides and skins in a solution of milk of lime?

In the course of its study of this problem, the leather research laboratory discovered that when a lime solution had been used for unhairing a hide or skin, methylamine was always present in the residual lime solution. This suggested a clue to the really active agent in the depilation of the hides, and led to very careful experiments. In every instance, introduction of methylamine into fresh lime solutions resulted in the speedier loosening of the hair.

A FURTHER study of the subject showed that methylamine was produced by the action of lime solution on the keratin, the chemical name for the epidermis of the hide, and also on the horns, hoofs, claws, and hair. Methylamine is produced very slowly in the reaction between the hides and the lime solution and is frequently mistaken for ammonia because of the similarity of the odors.

Exhaustive tests carried on at the leather research laboratory prove conclusively that the unhairing action of lime is caused by the production of methylamine in the solution; and that, by the addition of methylamine to a fresh lime solution, the time required to loosen the hair can be considerably shortened. Furthermore, the quantity of lime usually required for unhairing hides can be reduced measurably by the use of methylamine and, in consequence, the amount of waste lime sludge is reduced to a minimum. This is an important contribution to the problem of industrial waste disposal.

The work of the leather research laboratory of the Tanners' Council of America at the Univeristy of Cincinnati, Ohio, has fully justified the hope and expectations of those men in the leather industry whose vision and courage conceived it. In enlisting the services of science to solve their age-old problems, they have performed a notable public service because, without doubt, many new things will be learned about leather and tanning which will be reflected in a better quality of leather goods.

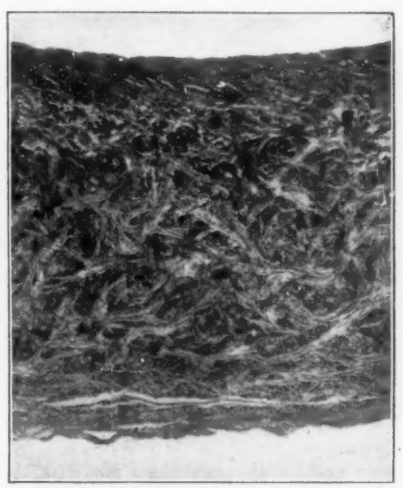


FRESH HIDE

Photomicrograph of a section of steer hide, showing the hair, hair pockets, et cetera

AFTER UNHAIRING

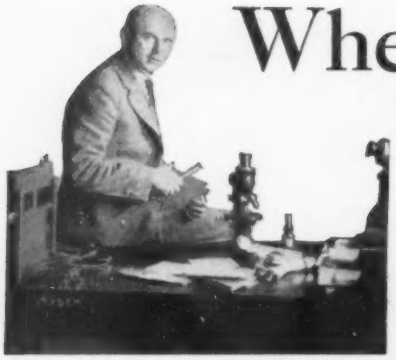
The action of the liming bath has loosened the hairs, and they have all been removed



FINISHED LEATHER

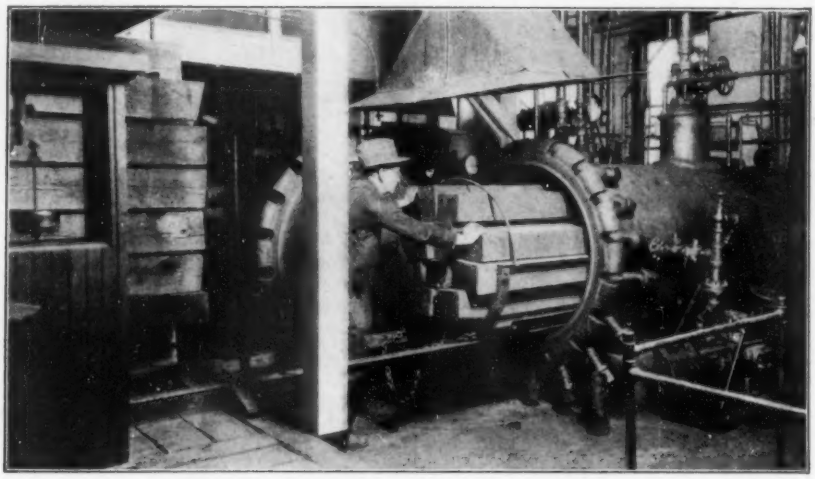
After the leather has been completely processed, a cross-section has this appearance

Where the Forest Meets the Laboratory



MICROSCOPE IS USED

The microscope is used as the basis for the identification of wood rather than by an examination of the botanical characteristics of the tree



EXPERIMENTING WITH RAILROAD TIES

A truck load of railroad ties is being pushed into the treating cylinder in the course of the study of the technique of wood impregnation. The laboratory conducts tests for the many species of wood which are impregnated with preservatives

TESTING LONG COLUMNS

A timber 30 feet in length is readily accommodated in the capacious jaws of the great 1,000,000-pound testing machine. The same giant tests the strength of built-up beams, trusses and girders—to complete destruction

MOISTURE RESISTANCE

These panels, after being finished with various wood coatings, will be weighed and put into constant-humidity rooms to determine the moisture resistance of the coatings. Exposure tests in the open are also made

TESTING FIBER BOARD

The inventor, Mr. T. A. Carlson, is operating a machine which subjects the board used for containers to repeated bendings and twistings so as to test the fiber's resistance. The scored board is being placed in the jaws

THE Forest Products Laboratory has the reputation of possessing great fascination from a scientific point of view, so one of our editors was sent to Madison, Wisconsin, a few months ago to collect photographs and get first hand information on this important governmental enterprise. The Forest Products Laboratory is a part of the research branch of the United States Forest Service. This laboratory—the first of its kind to be established—was started in 1910 for the study of the physical and mechanical properties of wood, its chemistry and pathology, and its manufacture, conversion, and use. Although the laboratory is housed in a building of the University of Wisconsin, it is administered solely by the United States Forest Service and not as a university department. Naturally, because of the complexity of wood and because of its myriad uses, the Forest Products Laboratory is divided into a number of investigative sections specializing on separate phases of the general problem. As the mechanical properties of wood are probably those of the most direct interest to the majority of users, the largest section of the laboratory is given over to the study of them. The wood preservation section is organized to develop preservatives, wood treating methods, and measures to cut down the largest single item of preventable waste that occurs in timber produc-

BENDING ARTILLERY WHEEL RIMS

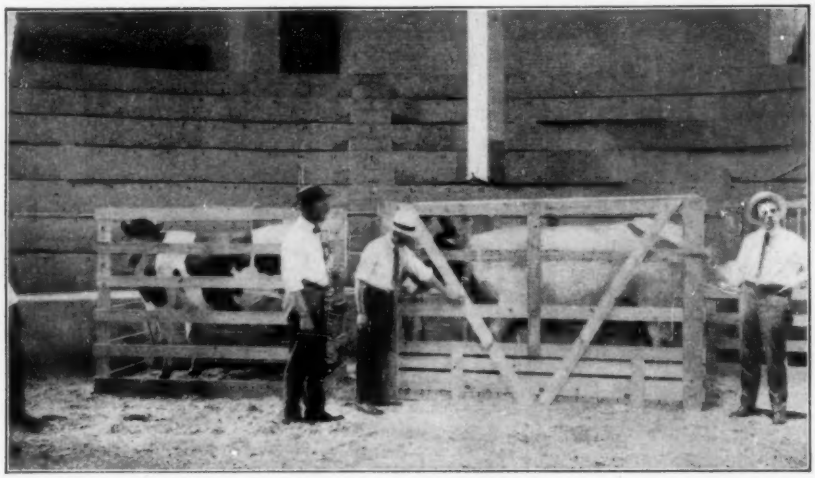
Prior to bending a wheel rim, it is steamed. It is then placed in the machine upon a sheet-metal strip and the end blocks are drawn in to bear down upon the squared ends. The two arms are then slowly drawn upward by means of chains and the piece is bent around the circular arc to conform to the wheel rim. A tension rod holds the ends together. When locked in this way the wheel rim may be removed from the machine and allowed to dry, whereupon it may be put to use

TESTING A BUSHEL BASKET

Special machines are used to test wood containers. They vary from small bench machines to huge tumbling drums which look like a feature in an amusement park. The work on containers has saved great sums

PRESSING GLUED BLOCKS

The operator is tightening the screws on glued test blocks. This material will later be made up into test blocks which will be tested by shear to throw further light on the best pressure and assembly time to use



TESTING COW CRATES

The cow crate shown at left is a type often used for livestock. The crate on the right was built according to a design developed by the Forest Products Laboratory. Some of the advantages which this crate has are greater rigidity, better protection to the animal, and easier loading. The rigidity is derived from the diagonal bracing; protection to the animal, from the greater length, from the built-in stanchion and from the heavier floor and closer spacing of boards near the floor

tion and use; that is, the destruction of wood by decay. Particular attention is paid to the fungi which stain or rot lumber. The derivation of chemical products from wood is extremely valuable because of the importance of the substances which we have thus far been able to obtain economically from no other source. The section of pulp and paper investigations is at present one of the largest and most active of the divisions of the Forest Products Laboratory, owing largely to the intelligent interest and co-operation of the paper industry. To assist shippers in improving the design of containers so as to obtain adequate strength with a minimum of lumber, the Forest Products Laboratory operates a well-equipped section for container investigations. One way in which the laboratory makes its findings available to the wood-using industries is by means of short intensive courses of study under the instruction of members of the staff. The records of the laboratories are filled with interesting experiences. For example, a piece of wood from a bomb which had exploded and killed the intended victim's wife was identified by the wood technologists as being the same kind as the shavings found around the workbench of the man suspected of sending the bomb. We are indebted to the Director, Mr. Carlile P. Winslow, for many courtesies.

THE PRIZE DISCOVERY

In the center is the arrowpoint, still in position between two ribs of an extinct bison

Glacial Age Man IN New Mexico

Remarkable Discoveries Made in the West Again Raise the Question, "How Old Is Man in America?"

By HAROLD J. COOK

Honorary Curator, Department of Paleontology, Colorado Museum of Natural History

The Editor Disclaims

IN the first two paragraphs of his most interesting article, Mr. Cook, the author, makes claims concerning the proof of the antiquity of man in America —claims which the editor regards as requiring a still larger volume of substantiation than the available evidence affords. With Mr. Cook's friendly concurrence, the present statement, in which the editor disclaims all responsibility for their inclusion, is published.

TO Fred J. Howarth and Carl Schwachheim of Raton, New Mexico, America is indebted for one of the most interesting and important discoveries of evidence concerning the presence of prehistoric man in the New World, during glacial or Pleistocene times. As more and more evidence comes to light, it becomes more and more obvious that this "new world" is not as new as it has been our custom to consider it. In fact, recent evidence proves it to be quite as old as the Old World, and it may have been inhabited by mankind quite as long. Some evidence at hand indicates that it may even have the older evidence of human occupation.

HOWEVER that may be, it is now obvious that mankind has lived on this continent for hundreds of thousands of years; and that even in early Pleistocene times had reached a stage of cultural development and civilization that was in some respects, at least, quite as advanced as any existing on earth at that time, insofar as present evidence indicates. Indeed the evidence now at hand, as a result of our recent studies and research in the field, testifies that mankind was even more advanced in the art of making stone implements in early Pleistocene times in America than in Eurasia, at least so far as denoted by present known data. Some of this has been given in earlier articles in the SCIENTIFIC AMERICAN and in *Natural History*.

Some two years ago, Messrs. Howarth and Schwachheim reported their discovery at Folsom, New Mexico, of some fossil "buffalo" (bison) bones to the Colorado Museum of Natural History, and arrangements were made at once to look into it. Our preliminary examination indicated an important fossil deposit and early in the summer of 1926 a party set to work excavating and carefully collecting these fossils. As this work, carried on for the Museum by Mr. Frank Figgins and Mr. Carl Schwachheim, proceeded, two arrowpoints of splendid workmanship and distinctive design were uncovered, each deeply buried and both definitely associated with these fossils.

SPLENDID skeletons of a bison (*Bison taylori*), new to science, and far larger than our modern species, were collected. These bones were exceedingly fragile, and great care and skill were required to collect, prepare and restore them for mounting. From this season's collection the skeleton of a large bull was mounted in the museum.

The following summer (1927), work was resumed in the quarry, and another large collection was made by Messrs. Schwachheim and Floyd Blair of the museum staff. Most of this is still packed in the field boxes in which it reached the museum, and is still to be worked out and studied in the laboratory. But in excavating in the field, more new arrowpoints were discovered. Five in all of this one distinctive type have been found associated with these extinct "buffalo." As work with the material progresses, it is quite possible that others will be uncovered, for it is quite easy to miss so small an object when taking out blocks of matrix filled with fossil bones in the field.

FORTUNATELY, one of these arrowpoints was located before it was loosened from the original deposit, while barely a tip of it was exposed. Here was the long-sought chance to show the world the occurrence and age

BEFORE EXCAVATION STARTED—FOLSOM BISON QUARRY

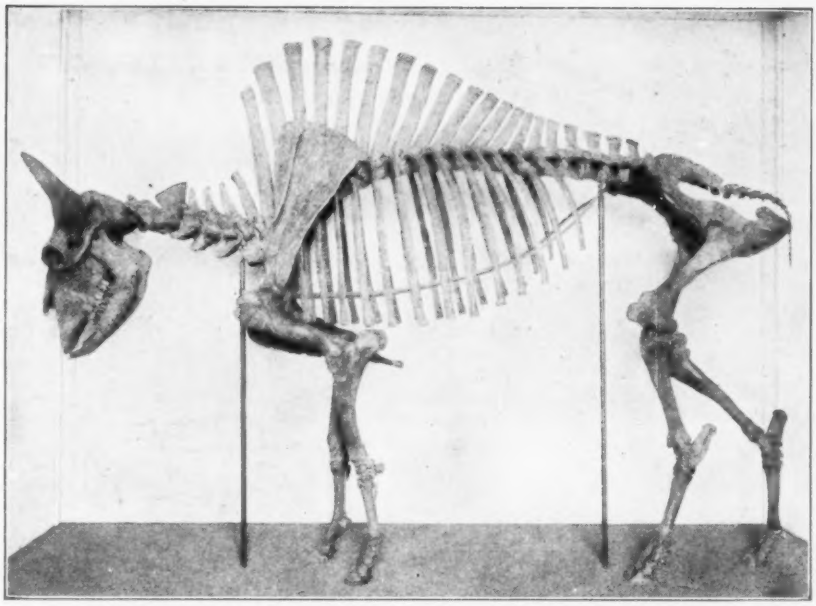
The dry gully or arroyo which cut through the fossil bed and caused its discovery on both side walls occupies the center of the picture. The bone bed lies 8 to 12 feet below the surface

of these implements, and convince skeptics that such association was bona fide and beyond question.

In previous discoveries of this nature, the human artifacts found had been loosened from the original matrix before being seen by scientists from other institutions and, until such evidence could be critically examined by competent, disinterested specialists, in position as nature left it, many were still inclined to remain unconvinced. Consequently, telegrams were sent immediately by Director J. D. Figgins, inviting several nationally known specialists to come to the spot and investigate for themselves.

AMONG those who came were Dr. A. V. Kidder, of Phillips Academy, Andover, Massachusetts, Dr. F. H. H. Roberts of the Bureau of Ethnology, Washington, D. C. and Mr. Barnum Brown, of the American Museum of Natural History, New York, all of whom were convinced of the authenticity and antiquity of this discovery. Mr. Barnum Brown was given the privilege of uncovering the upper side of this prize arrow. Later, it was carefully removed in a block, along with the bones with which it was associated, intact and undisturbed. In that form it is now on exhibition in the Colorado Museum of Natural History, at Denver, for all who care to see it.

The region where they were found is a most unusual one in which to find such fossils. Situated high up and near the head of what is virtually a mountain valley, in an area whose rocks are mostly lavas overlaying Cretaceous formations far too old to contain evidence of this sort, it is about the last place most collectors would set out for, in which to search for evidence of prehistoric man associated with fossils of this character. Conditions in and about the bison quarry show that the valley in which it is situated had been cut or eroded more deeply in Pleistocene times than it is to-day.



A BISON LIKE THAT WITH WHICH THE ARROW WAS FOUND

The mounted skeleton is now on exhibit in the Colorado Museum of Natural History at Denver. This species, Bison taylori, *is extinct—how long since, is unknown. It was very large*

IN later Pleistocene times a refilling period set in, caused possibly by the temporary blocking of the valley below by a lava flow. In any event, on the old eroded surface of Cretaceous shales, clay-muds and silts are deposited. Their character indicates swampy conditions and comparatively quiet waters, at the spot where the bison are deposited, as the matrix is free from coarse materials such as sand and gravel, which characterize stream beds in such a location as was this one.

Another stage of recutting has set in comparatively recently, channeling back up across the present valley floor. A deep, narrow little gully or arroyo was thus formed by waters from hard rains and melting snows. This gully cut through the bone bed, destroying part of it, and leaving the ends of bones exposed in its two walls, which led to their discovery.

Three principal phases of deposition are represented in these sediments, two of which overlie the level in which the fossils and arrows occur. The bone bed lies at a distinct angle, dipping down to the north across the arroyo, and lies at a depth of about eight to twelve feet below the present surface.

Fortunately, Mr. Fred Howarth, formerly connected with the United States Biological Survey, realized their possible importance when he saw them, although no one connected with the discovery really expected to have the good fortune that has followed operations there.

WHERE THE ARROWPOINT WAS DISCOVERED

Mr. Carl Schwachheim points to the arrowpoint, which is still in position where uncovered. Mr. Barnum Brown, well-known vertebrate paleontologist, who uncovered it, kneels at the right

AFTER our earlier discoveries at Colorado, Texas, (described in the SCIENTIFIC AMERICAN, November, 1926), we knew and discussed the possible chances of finding evidence of prehistoric man here, and everyone was warned to keep the sharpest watch for such; but it was almost too much to hope that our wishes could be fulfilled in such a manner as they were.

The fact that these arrowheads were found under the conditions they were, makes it possible to designate it as evidence of a definite cultural stage, for which the name "Folsom Culture" has been suggested. They are rather large for arrowpoints, and

THE QUARRY AFTER PRELIMINARY STRIPPING

The skeletons remain in the central mass which has been carefully isolated. From this stage on, the work demands skill, care, and patience

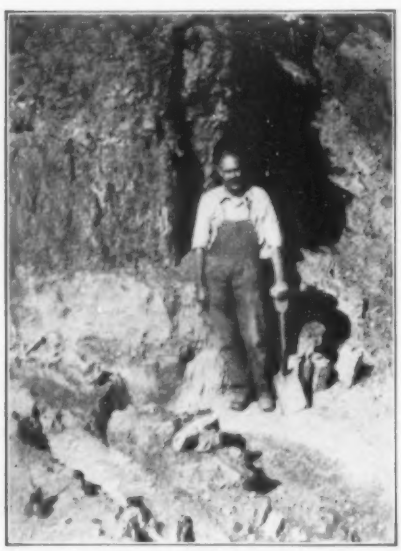
FOUR OF THE SPLENDID ARROW POINTS

The editor, who has handled the points, feels that the pictures fail to convey their extreme refinement. They were the work of an expert

small for lance points; but no matter which their use was, their purpose seems clear, and it seems entirely likely that they were carried to this spot in the bodies of these bison.

OF course such an animal might be shot in countless places by an arrow, and still escape his human enemy to carry the points away in his wounds. Buffalo like to wallow and roll in mud-holes, as is well known; and wounded, feverish animals would naturally seek cool waters to lie down in when suffering from such wounds. No doubt some of the animals whose skeletons we find here did just this and, lying down, never got up again.

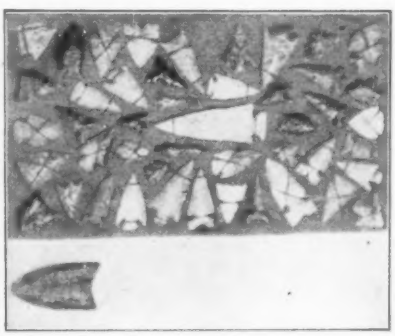
A glance at the illustrations will show



MR. SCHWACHHEIM PAUSES

Here he stands close beside the bone bed, which shows in the lower lefthand corner

the shape and form of these arrows better than words. The most striking feature is that, after they were chipped out and formed, a long thin flake or chip was taken out of both sides, lengthwise, from the rear toward the point, leaving the arrow, in cross-section, with a hollow-ground effect. To do this required a higher degree of skill in the art of stone working than that possessed by most races which have made stone implements. Those primitive people, in shaping the flints, caused this long chip to break out in a most skillful manner. It is not easy to understand how this could be done without its breaking out crosswise and ruining the point. Of course, this



FROM EASTERN COLORADO

A typical collection of arrowpoints which was later found to include two of Folsom type (one of these is in the corner)

chipping takes advantage of the conchoidal fracture characteristic of this class of stones, but utilizes it in a remarkable manner.

The double grooving of the arrows probably served two useful purposes. It offered a good seat on which to secure the shaft of the split stick on which it served as a point or head; and second, such a point permitted a wound to bleed more freely. Bayonets similarly shaped were used in the World War.

The materials from which these points were made differ somewhat in each specimen, but all belong to the one general class of silicates, comprising flints, chalcedony, agate, jasper and their related varieties.

A few other points of this same general type and design have been located at other points in New Mexico and Colorado, either on the surface or mixed with more modern types of workmanship at village sites; but all are from an area probably traversed by the race of men that killed the Folsom buffalo. Although a few points have been found in association with those of more modern type, they had probably been discovered and picked up by later Indians, after having been eroded out from their original place of deposition where buried or lost by their makers. There is no data at hand to indicate their manufacture in this country by more modern races, although modifications of this type are comparatively common.

Until other discoveries are made, it is premature to say what manner of people this evidence represents. Perhaps they were a wholly different race. Who knows?

IMPROVISED SHELTER TENT

At times violent, sudden storms interrupted the progress. Work continues this summer

How the Weather Man Outreaches the Airplane

THE RELEASE

Beneath the balloon is a light weight parachute which is automatically detached when the balloon has reached its "ceiling." The parachute "rescues" the recording apparatus

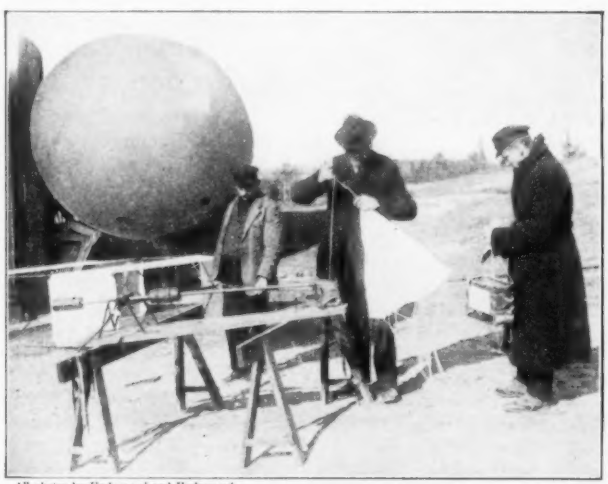
MAN has flown about eight miles above the surface of the earth but the meteorologist seeks to extend the domain of his scientific investigations far higher than this. For this purpose, the sounding balloon and the pilot balloon serve better than anything so far devised, although recent research gives promise that powerful rockets will some day be able to rise far higher, if not entirely out of the earth's atmosphere. As the illustrations reproduced on this page indicate, the sounding balloon is designed to carry aloft scientific apparatus of light weight, and balloons of this type have been sent to an elevation of about 22 miles; the pilot balloon referred to above is smaller and carries no apparatus, hence flies to 24 miles elevation. The illustrations on this page show sounding balloons.

"The registering apparatus sent aloft by these various methods," says the noted meteorologist, Dr. William J. Humphreys, Chief Physicist of the United States Weather Bureau, in his "Physics of the Air," "furnishes reliable information concerning the composition (including humidity), temperature, pressure, direction of motion and in some cases, velocity of the air, from the surface of the earth up to the greatest elevation reached. And it is this automatically recorded information, gathered, with but little exception, since the beginning of the Twentieth Century, that has so greatly extended our accurate knowledge of meteorology and done so much to make of it an interesting and profitable branch of both theoretical and applied physics."

The balloon activity depicted on these pages is at the Lindenberg Observatory, near Beeskow, Germany, but the methods employed are virtually the same the world over. Professor W. H. Hobbs, leader of the University of Michigan Expedition to Greenland, has released many sounding and pilot balloons over that land, in his recent efforts to study the meteorological conditions of the arctic. It is his belief that much of the weather of the north temperate zone is "brewed" in the high, cold plateau of Greenland, and observations he is now conducting may prove of great practical value.

THE OBSERVATION

With the theodolite, a pilot balloon is being observed in its flight. When thus checked simultaneously from two stations the course of the balloon may be plotted by triangulation



All photos by Underwood and Underwood

SENDING UP A SOUNDING BALLOON

The natures of the parachute and the simple package containing the automatic recording apparatus are clearly shown. The picture contains other, unrelated apparatus which is not taken aloft

CHECKING UP WITH A RANGE FINDER

A pilot balloon may be watched in flight by means of an optical range finder. This makes its triangulation automatically, doing the work of two theodolites—that is, it provides its own permanent baseline

Courtesy American Museum of Natural History

TYPICAL COUNTRY OF NORTHEASTERN SIBERIA

The part of Siberia in which the meteoric fall took place is mainly covered by forests of conifers, but there are local areas which are more or less like tundras. The real barren tundras are farther north

The Great Siberian Meteorite

An Account of the Most Remarkable Astronomical Event of the Twentieth Century, from Official Records

By CHAS. P. OLIVIER, Ph.D.

Chairman, Meteor Commission, International Astronomical Union
Astronomer at the Leander McCormick Observatory, University of Virginia

THE readers of the SCIENTIFIC AMERICAN will remember the very interesting series of papers on Meteor Crater, Arizona, by D. M. Barringer, Jr., that appeared last July, August, and September. Meteor Crater has often been described as "the most interesting place on earth" to the scientist, and most justly so.

There undoubtedly we have a great crater nearly a mile in diameter and several hundred feet deep, made by the fall of an immense group of meteorites or, more properly speaking, the head of a small comet. All evidence is that the fall took place well within historic times, even if no authentic account survives and only a few Indian legends may be connected with it. The actual exploration of this crater, now under way, will, it is hoped, in the near future give us information of the vastest importance.

Recently reports have been reaching the scientific world of a wonderful meteoric fall in one of the most inaccessible parts of Siberia. During the past year there have been several references to it in scientific and popular journals, but the official account of the exploration of the locality by an expedition sent out by the Academy of Sciences of the U. S. S. R. (as Russia now calls itself) has only just been received. This expedition was under the direction and leadership of Prof. L. A. Kulik, and the following details are taken from his report, which must be considered the first authentic and scientific account to be published of this most remarkable phenomenon.

The reason that most of the world has remained in ignorance of this meteoric fall has been due both to the difficulty of communication with Russia in general and to the fact that nearly all publications from that country now appear in Russian, which few foreigners can read. So the earlier notes on this fall seem to have been largely overlooked and only recently has attention been focussed upon it outside of Russia itself. Yet Prof. Kulik published a note upon it as early as 1921.

THE fall itself occurred on June 30, 1908, in the upper basin of the river Podkamennaja Tunguska, in central Siberia, at about latitude 60 degrees north, and longitude 101 degrees east of Greenwich. The sparse population of the region, its distance from any centers where there were many Russians, and the generally disturbed condition of the whole country for the past 25 years, will readily account for the slowness with which the rest of the world has learned of it.

From other sources we are informed that seismographs at Irkutsk and Kirensk, 800 miles and 300 miles, respectively, from the place of fall, registered the shocks. A barograph at Kirensk also registered the accompanying airwave. The general direction of motion of the meteorites seems to have been from S. S. W. to N. N. E. It is barely possible, according to recent calculations by V. A. Maltzev, that these bodies had formerly been connected with Pons-Winnecke's Comet—the one which was visible last summer.

The expedition under Prof. Kulik reached the general vicinity of the fall in March, 1927, and made its base at a small trading station named Vanovara, situated on the above-named river, about a hundred kilometers to the southeast of the area to be investigated. The country is described as rough, hilly, with many swamps and small lakes, and much of it densely covered with tundra. This last was so difficult to penetrate that, after numerous attempts, members of the expedition were forced to employ small rafts and work their way slowly to the northwest, using the system of rivers which inter-

sect the district. Finally, in June, they reached the spot and a preliminary survey was made. Apparently they arrived with a very small scientific equipment, for they were unable to make many of the kinds of observations that Prof. Kulik desired, and which he states are necessary. But his survey was quite sufficient to prove that whatever did happen was the most astonishing phenomenon of its kind in scientific annals.

THE central part of the affected area which is altogether 15 or 20 miles in diameter, covers an area of several square miles and is situated on the plateau between the rivers Chunia and Podkamennaja Tunguska, where there is a sort of enormous amphitheater formed by the surrounding mountains. This valley has many hills, swamps, creeks, and is largely covered by the tundra. The natives assured Professor Kulik that the whole valley was formerly covered by woods. The trees are now bare, without bark or limbs, and almost all lie on the ground with their tops turned away from the center of the spot, thus giving a sort of fan effect which is plainly visible from the tops of some of the surrounding mountains. Here and there some tree trunks still stand and, in a few isolated and very sheltered spots, some that are still living. But the region is in general now most desolate.

All the vegetation shows the effects of a uniform and continuous scorching, which does not in the least resemble the consequences of a forest fire. The scorching is visible also on the moss and bushes, as well as the trees, and some signs of it appear as far out as 6 to 10 miles from the center.

But the thing which gives the whole phenomenon its most decidedly meteoric character is the presence of innumerable "shell-holes" or craters which vary in diameter from one to perhaps 50 yards in diameter, scattered all over the central area. Their edges are mostly steep, the bottoms flat and swampy, and sometimes with traces of a central elevation. Actual digging into one of the smaller "shell-holes" for a few yards depth did not yield any meteoric mass, but in such ground this was hardly to be expected, for a solid mass would undoubtedly sink to some depth, and the expedition was not equipped to dig deeply in soil in which water was always present just a little way below the surface.

No exact mention is made of the area covered by these "shell-holes," nor whether any of them occurred upon higher ground where digging would not be interfered with by water. But the inference is that they were confined to low ground which by chance formed the exact central area.

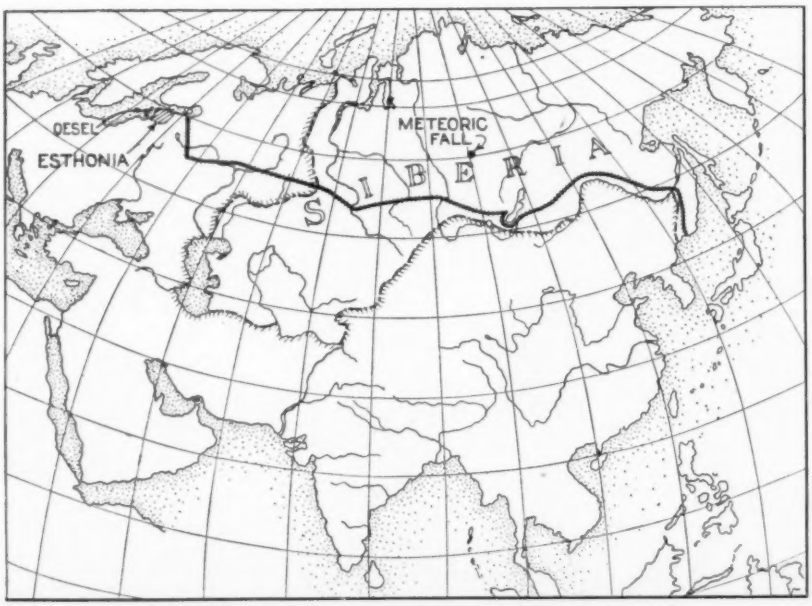
From those who actually witnessed the phenomenon Professor Kulik was able to obtain several very good accounts. Perhaps the best was that by a peasant, S. B. Seminov, who was on that date at the station Vanovara. He says:

"About eight o'clock in the morning, I had been sitting on the porch with my face to the north, and at this moment in the northwest direction appeared a kind of fire which produced such a heat that I could not stand it. . . . And this overheated miracle I guess had a size of at least a mile. But the fire did not last long, I had only time to lift up my eyes and it disappeared. Then it became dark, and then followed an explosion which threw me down from the porch about six feet or more . . . but I heard a sound as if all houses would tremble and move away. Many windows were broken, a large strip of ground was torn away, and at the warehouse the iron bolt was broken. . . ."

Courtesy American Museum of Natural History

TUNGUSES AND SUMMER TENT

The Tunguses are a northern Mongol people kindred to the Manchus. They inhabit most of Northeastern Siberia and are nomads. To some extent the Slavs have penetrated Siberia



SHOWING WHERE THE METEORIC FALL TOOK PLACE

The distance to the Trans-Siberian Railroad, which is indicated on the map, is about 400 miles. The editors, who prepared the map, have also indicated on it the locality referred to on page 45

PROF. KULIK also learned from one of the native Tunguses that the spot where all the trees are now dead had previously been used by a rich relative as a pasture for a large herd of tame deer. After the fire they went to find the herd and found many scorched carcasses, but never found a large part of the herd, dead or alive. Also some small storehouses in which the man used to keep implements, and so on, were all completely ruined; everything in them being either burned or melted, so that only a few buckets remained fit for use out of all his property. There were other eyewitnesses, both Russian peasants and native Tunguses, whose accounts tallied in essentials with those mentioned above.

Professor Kulik concludes by outlining the sort of work that must be undertaken by a scientific expedition, on a larger and more complete scale, before it would be wise to begin digging for the actual fragments. He further calls attention to the fact that we have no record of the fall of any other meteoric mass which brought along with it a vast envelope of hot gases, and which did such damage over a large area.

In looking over this account, one has to admit that many accounts of

Courtesy of American Museum of Natural History

A TYPICAL NORTHERN SIBERIAN LANDSCAPE

While no actual photographs of the exact locality described are as yet available, this and others published will suffice to give a general idea of the kind of country where the meteorite fell

events in old chronicles that have been laughed at as fabrications are far less miraculous than this one, of which we seem to have undoubted confirmation. Fortunately for humanity, this meteoric fall happened in a region where there were no inhabitants precisely in the affected area, but if such a thing could happen in Siberia there is no known reason why the same could not happen in the United States.

FROM the standpoint of meteoric astronomy, the final verdict can scarcely be given until some fragment of the fallen mass can be produced, and the region fully studied. But good reasons have been given why this, so far, has not been done. The available evidence points perhaps to a much less dense mass of meteorites than that which formed Meteor Crater in Arizona, but it also seems to have had a larger cross-section. When it struck the ground it was surrounded by an immense envelope of extremely hot gases, but it is a question whether much of this gas had accompanied the solid masses through space, or whether most or all of it was not simply some of our atmosphere carried along by the passage of the solid masses through it, as we know to be the case for even small meteors. Lacking further evidence the writer would guess that the latter was the case.

But it is certain that the velocity of the masses when they struck the surface of the earth was very much greater than is usually the case for a single meteoric mass, which never has been known to penetrate very deeply into the soil. This would mean that these masses presumably will be found at considerably greater depths than usual. The fact that the bodies fell at eight in the morning also inherently proves that the velocity, relative to that of the rotation of the earth's surface, was greater than that of the average meteorite, most of which fall in the evening hours.

The area of the larger "shell-holes" or craters further proves that some of the individuals were of considerable size, probably a yard or two in diameter, as a lower estimate. Not until specimens are recovered will it be possible to give even an intelligent opinion as to their probable constitution, that is, whether they are stony or iron meteorites. A photograph from an airplane, as Professor Kulik suggests, would be invaluable, for it would show the distribution and number of these craters, without which information we can form no just estimate of the number of bodies which fell.

If we seek through a search of scientific literature to find a parallel effect produced on vegetation we find that only by a volcanic eruption has one more or less similar been brought about. But unless the explosion took place in the center of the affected area this possibility is at once ruled out, and as no mention is made of volcanic phenomena in the report of the expedition, presumably this cause cannot be assigned.

IT is hoped that no pains will be spared by the proper authorities to investigate fully and explore this region in the near future, for each year that elapses will destroy some of the evidence. Certainly what we now know of it places this phenomenon in a class wholly by itself, and not only meteoric astronomy but science as a whole will profit greatly by the solution of the many interesting problems that it presents.

The assistance of Dr. A. Vyssotsky of our staff is most gratefully acknowledged for the translation of the original document, without which the writer would have been unable to undertake the preparation of this article.

¶ *An old controversy in science has been revived by the recent statement of a noted American scientist, that the living races of man are direct descendents of the ugly, ill-formed Neanderthal species. In a coming issue, a famous authority on man's bodily evolution will attempt to controvert that claim.*

Courtesy American Museum of Natural History

A TUNGUS FAMILY AT HOME ON A SUMMER DAY

Siberia is peopled with many widely differing peoples. The Caucasian race has infiltrated only along the line of the great railroad and in isolated spots where commerce brings them

A Miniature Meteor Crater

A Circular, Crater-like Depression in Esthonia Bears at Least Superficial Resemblance to the Famous Crater in Arizona

By ALBERT G. INGALLS

GEOLOGISTS of the University of Dorpat in the small country of Esthonia lying between Russia and Scandanavia, on the eastern shore of the Baltic Sea, are endeavoring to discover the mysterious origin of a peculiar geologic feature on the nearby island of Oesel or Saaremaa. (See map on page 43.) There, 14 miles northeast of the ancient city of Arensburg, or Kuresaar, in the immediate vicinity of the little village called Kaali or Salle, is a nearly circular depression like a crater, not more than 300 feet in diameter and surrounded by a wall or rim which stands 15 or 20 feet above the level of the plain in which the strange depression occurs.

The question which intrigues the local geologists is whether this anomalous feature of an otherwise flat, featureless landscape is simply an ordinary case of ground water solution of the rock with the caving in which commonly produces what are known in the American middle west as "sink-holes," or whether we have here another though smaller "Meteor Crater" like the famed mile-wide depression in Arizona which is now being probed by means of a shaft for the large meteoric aggregate which is thought to have excavated the crater in its fall.

These two theories—the sink-hole theory and the meteoric crater theory—coincide with two of the three theories originally advanced to account for the Arizona crater, and have been mentioned by the well-known geologist, Professor Alfred Wegener of the University of Graz, Austria, the same Professor Wegener whose theory of drifting continents has been widely dealt with in popular journals. The third or volcanic theory of the origin of craters has not been introduced in this case, because there are no signs of volcanic activity within hundreds of miles of Esthonia. Nor does the glacial moraine, kettle-hole hypothesis seem to fit the circumstances.

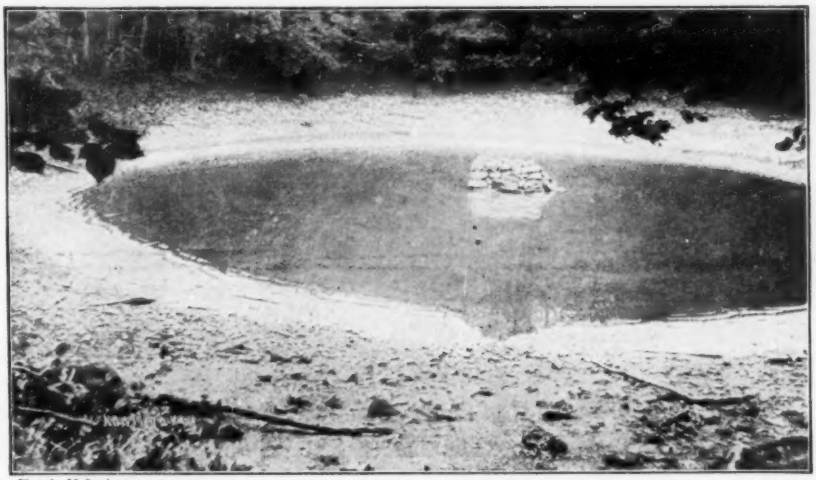


Photo by M. Jacobson

THE SMALL LAKE IN THE CENTER OF THE CRATER

The lake is 14 feet deep, but it does not occupy all of the crater. From a geological point of view its presence in the bottom of the depression is not significant

THE particulars of the description of the crater on the island, which forms a part of Esthonia, were furnished by Mr. Konstantin Komets of Reval, capital city of that nation. The surface soil, he states, is black earth with clay beneath, then sand, reaching in all to a depth of about 10 feet. Below this is dolomite. This variety of rock is closely allied to limestone, being composed of the carbonates of lime and magnesia. This renders it necessary to take very serious account of the sink-hole theory, for dolomite, like limestone, is soluble in ground water and it would not be far-fetched to attribute the origin of a crater to the same agency which often dissolves out limestone and brings about the formation of the familiar sink-holes which sometimes engulf whole fields when the fall of the unsupported surface strata suddenly takes place.

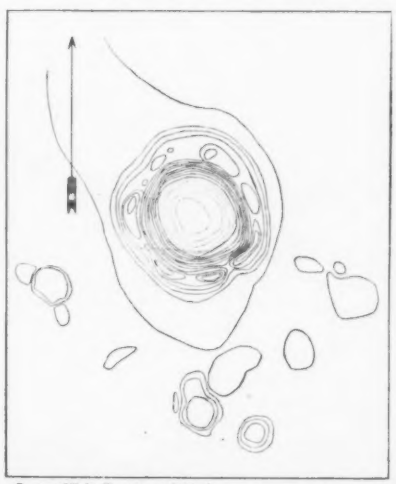
There are, however, several other features which seem to provide a peg on which to hang, at least tentatively, the meteoric theory. The crater, so far as its actual depth is known, ignoring any silting up which may have taken place subsequent to its original formation, extends to 30 feet below the top of the exposures of dolomite, the total thickness of which our correspondent does not specify. Under this dolomite a deposit of dolomite powder mixed with larger stones has been found. This, taken in conjunction with the stated facts that the rocks of the crater's rim are tilted up as if resulting from the impact of a projectile, as are some of those in the rim of the Arizona crater, and secondly, that the rim of the crater stands 20 feet higher than the outside level of the plain, constitute a mass of evidence which demands further consideration of the hypothesis of meteoric origin.

Within a distance of half a mile, as shown by the accompanying contour map furnished by Mr. Komets, there are 12 or more smaller craters ranging from 100 feet down to 15 feet in diameter. It would seem that, if the main crater owed its origin to the same events which excavated the colony of small craters, and if this was truly the impact of a swarm of meteorites, it ought to be possible to settle the question by exploring a small crater.

Courtesy of A. Luha, University of Dorpat

A PART OF THE WALL

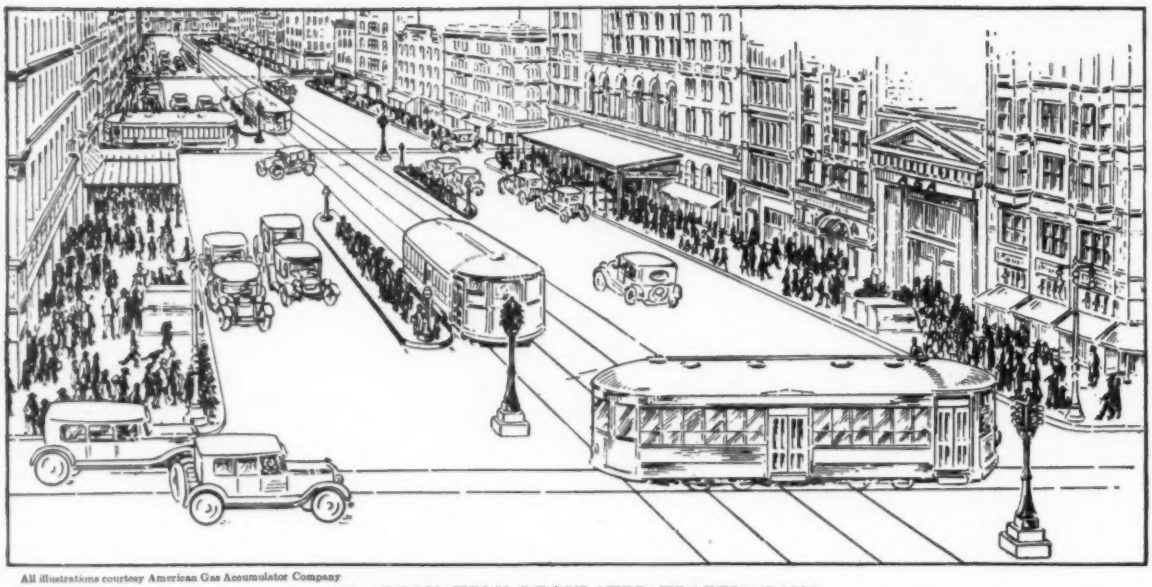
What forces tilted these strata? See map, SCIENTIFIC AMERICAN, July 1926, page 53



Courtesy Mining Department, Esthonia

MAP OF THE CRATER

Contour interval is one meter. A colony of small craterlets is indicated at one side



All illustrations courtesy American Gas Accumulator Company

AN ADEQUATELY REGULATED TRAFFIC ZONE

In this illustration, "Stop and Go" signals are so placed that they not only control traffic by their changing lights, but they also regulate the flow of vehicles so that each is kept in its proper lane. Safety zones for pedestrians also have a very definite regulating effect on vehicles

Traffic Regulation

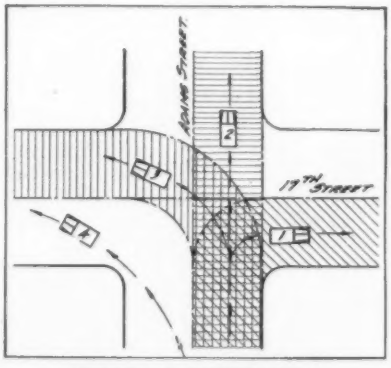
An Analysis of Accident Causes, and Suggestions for Correction. Traffic Beacons and Safety Zones Can be Made of Great Value When Properly Placed

By GUY KELSEY
Traffic Engineering Division, A. G. A. Company

TRAFFIC regulation is defined as means by which the movement of traffic is confined to proper channels and disorderly movements are prevented. A signal to accomplish this is a *regulating* signal. *Traffic control* refers to means by which traffic may be halted. A "Stop and Go" signal is a *control* signal. Regulating signals should be used at the majority of intersections to maintain a fluid and orderly movement of vehicles and to safeguard pedestrians. Control signals should be used at heavy traffic points and only during the hours when traffic is heavy.

IT is often wise to install control "Stop and Go" signals on pedestals in the throats of the minor street to operate "Stop and Go" during heavy traffic hours, to be turned on as flashing signals during light hours and allow the continuous safe movement of traffic without stopping, and to regulate the movement of traffic and safeguard pedestrians at all hours. In this way, the signal lights may be placed in the position of greatest visibility. Traffic control and traffic regulation are thus provided for the same expenditure and an efficient 24-hour treatment is the result.

Accident data indicates that 90 percent of traffic accidents occur outside of business hours, and that 75 percent of all accidents occur at street intersections. Heavy traffic is the safest. As a matter of fact it is about 15 times safer to cross the street through heavy traffic in business hours than at night when traffic is light. This illustrates the truth that the accident hazard decreases as congestion increases and vice versa.

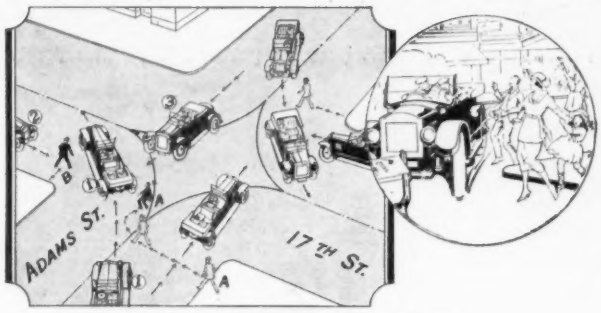


KEEP TO THE RIGHT

Figure 1: *If there were no such rule, many of our streets would be impassable. This rule divides traffic into two separate lanes*

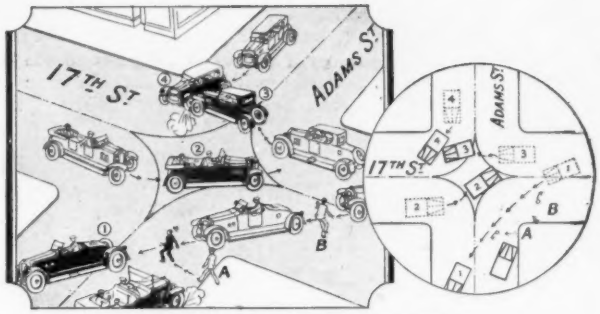
A traffic accident is the result of something unexpected and unlooked for, and is not a premeditated act. Irregular movements, particularly those arising out of left turns, are the cause of most intersection accidents. Such irregular movements introduce uncertainties which result in accidents.

WITHOUT the rule "Keep To The Right" our streets would be impassable. This rule divides the street into two parts; traffic goes north, for example, on one side of the street, and south on the other. It will be clear that vehicle 1 in Figure 1 turning right, or vehicle 2 going straight through, are not likely to get out of their proper channels. Vehicle 3, turning left, continues in its proper channel in Adams Street to the near curb line of 17th Street and enters on the right side and in proper path in 17th Street. Vehicle 4, making a short cut left turn, gets into the wrong channels of both Adams and 17th Streets and violates the rule "Keep To The Right."



UNEXPECTED LEFT TURNS

Figure 2: *In this case, car 1 is making an improper left turn, and is traveling faster than it should. The result is complete confusion*



THE DANGEROUS DRIVER

Figure 3: *The dangerous driver is the one who starts all the trouble. Here car 1 cut across the corner, and created the confusion illustrated*

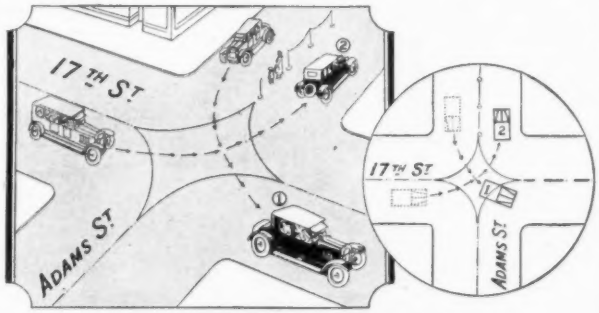
In Figure 2, driver 1 is making a short left turn and is going faster than he should. Pedestrian A saw car 1 coming, but expected it to pass behind him, and turned his attention to car 3 as his next danger. He just escapes. Pedestrian B looking, as he should, in the direction of car 2, steps directly into the path of car 1. Driver 3 is looking in the direction of car 2 and sees car 1 almost too late to avoid an accident. In each case drivers and pedestrians were looking in another direction and had no reason to expect the dangerous movement of car 1. Vehicles making a short left turn move on the wrong sides of two streets and always strike from behind.

CAR 1, in Figure 3, cutting the corner at speed started all the trouble. Pedestrians A and B, looking for cars in other directions, just save themselves. Driver 2 deflects left to avoid accidents and car 3, in dodging him, collides with car 4. Driver 1 goes his way and driver 3 will be charged with reckless driving. Car 1 in cutting short, started a general disorder and unexpected movements which resulted in an accident.

Suppose that stanchions are placed in a row, as shown in Adams Street, Figure 4. They compel driver 1 to stay in his proper channel until he comes out to the curb line of 17th Street. Turning left from this point, he finds it hard to enter 17th Street, except through the correct channel into that street. In fact, the faster he moves, the surer he is to make the turn correctly.

In the same manner, driver 2 finds he must continue out to the curb line in 17th Street to make the easiest turn into Adams Street. If he cuts short, he is blocked by the row of stanchions. Both drivers find improper left turns blocked and correct turns the only ones they can make conveniently.

Suppose a barrel is placed in the throat of Adams Street and on the curb line of 17th Street opposite the row of stanchions, as in Figure 5. This treatment would correct the left turns into and out of that side of Adams Street. It would have the same effect as the row of stanchions on the other side of the street. The basic requirements of a signal to regulate the movement of traffic and to keep it orderly will be met if a light is placed on the barrel at night. The completed treatment shown corrects all left turn movements within the intersection, keeps traffic in good order and in proper channels.



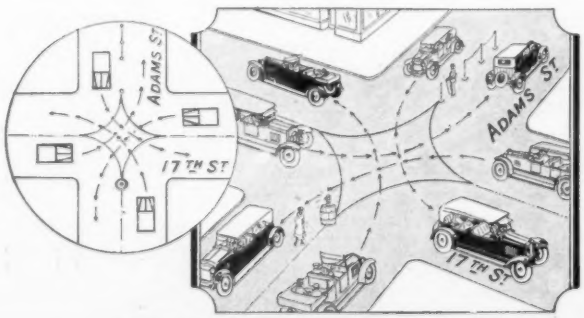
ENFORCING PROPER PATHS

Figure 4: *By the placement of a row of stanchions in Adams Street as shown, cars must stay in their channels until at the turning point*

THE preceding illustrations establish that: traffic may be expected to take the easiest and most convenient course; that the short-cut left turn produces unexpected movements, disorder, and accidents at intersections; and, that one way to prevent the disorder which causes accidents is to place signals in the path of traffic, so that they obstruct improper movements. This can be done without interfering with proper traffic paths.

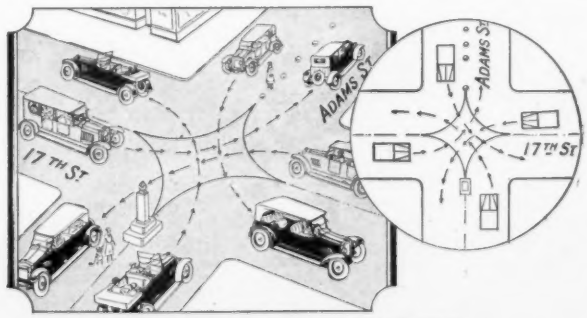
The treatment shown in Figure 6 employs a signal in one throat of Adams Street to warn traffic in all directions and a row of marker buttons which produce the effect of a curbing, in the opposite throat.

In some street intersections, one signal is not adequate and two must be placed in service. In Figure 7 note the safety zone or refuge value of the installations to pedestrians crossing the streets through traffic.



OBSTRUCTING WRONG MOVEMENTS

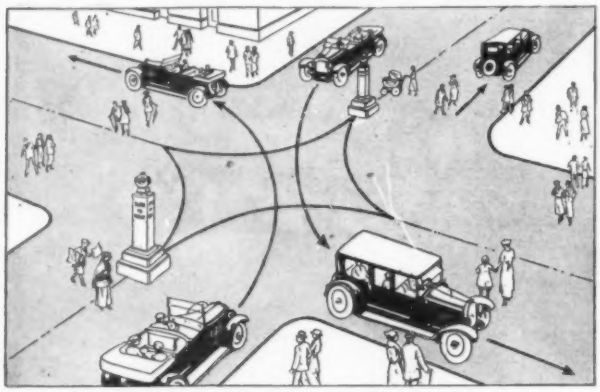
Figure 5: *An obstruction placed in Adams Street, in addition to those shown in Figure 4, serves to aid still more in regulating traffic*



TRAFFIC SIGNAL AND MARKERS

Figure 6: *A further treatment of the corner illustrated in Figure 5 at the left is the use of a flashing beacon and a row of marker buttons*

Properly placed, signals to regulate traffic, as shown, will pass more vehicles and pedestrians with safety than before treatment. The reduction of accidents usually exceeds 90 percent. Signals which regulate traffic movements without the "Stop and Go" feature place the emphasis on the "Go" and not on the "Stop," an important point, since unnecessary delays to traffic place an excessive burden of cost on the community.



SAFE ZONES FOR PEDESTRIANS

Figure 7: *Here flashing traffic beacons are placed at both sides of the cross street. Note how they serve as refuges for crossing pedestrians*

IT required four officers to handle the intersection in a large city park, shown in Figure 8. Traffic intersected at sharp angles, in some cases almost head-on. With plenty of space, traffic tends to roam. In this case each driver suited his convenience as to routing, thus increasing the confusion. There were six major intersection areas (shown shaded), which formed a series of dams in the path of the main streams of traffic. Traffic seemed to come from and to go in all directions. There were no definite channels for traffic. No one knew what the others would do and the resulting disorder caused accidents, confusion, and, during rush hours, serious congestion.

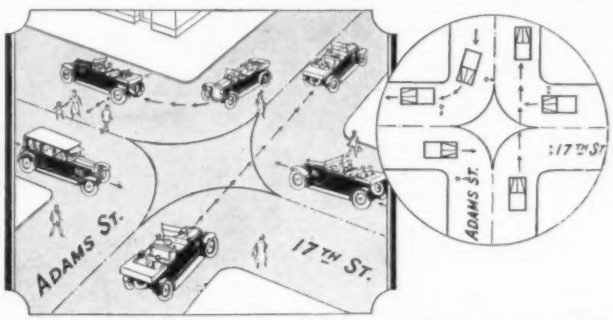
The problem was solved, as pictured in Figure 9, and all four officers transferred to other duties in 1921. In spite of greatly increased traffic, it remains solved, and accidents and congestion have been eliminated. Three triangular areas were installed with flashing beacons on the traffic approach ends. These installations limit traffic to definite channels. Wrong movements are obstructed without interfering with proper paths which were made most convenient. Six intersection points are reduced to three which are at right angles and out of the way of traffic moving along the sides of the area. Pedestrians have safety zones for their protection. Everyone knows definitely what to expect of everyone else.

EACH step in this analysis has been carefully checked by many observations at street intersections over a period of years. In addition, thousands of difficult traffic problems have been successfully treated and accidents eliminated through the application of the principles outlined.

Signals in the street are believed by some to interfere with traffic, because they are sometimes struck. Many officials, however, consider that the more a signal is hit, the more apparent the need for it.

It is felt that if a motorist strikes a signal, he will strike other vehicles, or certainly hit pedestrians who carry no lights, and that such a motorist is one of that small group which causes most of our traffic troubles. A check of motorists striking signals indicates that over 75 percent were under the influence of liquor.

Signals, properly placed in the street, do not interfere with traffic, but are an aid to its fluid and safe movement, and even clear up congestion at an intersection.

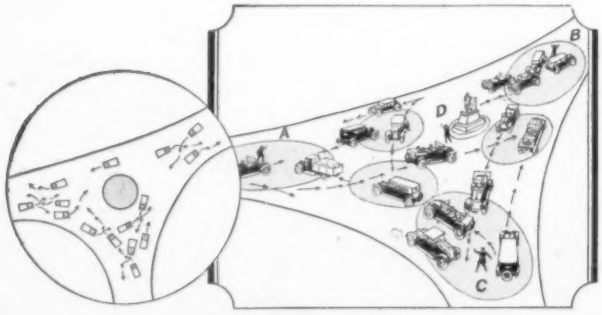


EXPECTED VERSUS UNEXPECTED

It is usually in the case of left-hand turns that accidents happen. Through traffic drivers can judge quite accurately what the other driver will do, except when the other driver turns left unexpectedly and in the wrong manner. Then accidents often will happen, as is illustrated in the drawings on this and the two preceeding pages. As shown above, cars making right-hand turns are usually safe

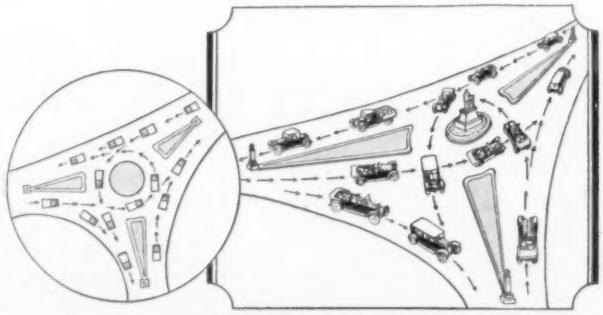
IN conclusion, it is suggested that the ultimate solution of traffic accidents at street intersections is the elimination of disorderly movements and the channelization of traffic. This can be accomplished by a signal correctly placed in the throats of intersecting streets.

According to a recent report of the Commissioner of Motor Vehicles of the state of New York, it is the experienced driver, or rather the driver who has been operating a car for a long time, who creates a greater percentage of the accidents than the driver who has possessed his license but for a short time. This is due, no doubt, to the fact that experience is likely to breed recklessness, whereas the newer driver does not have the confidence to take chances. The moral is obvious: Take no chances; keep to the right; obey traffic signals. If these three rules are kept in mind, traffic accidents will be reduced to a mininum and congestion will be relieved.



TRAFFIC DISORDER

Figure 8: *At this point, traffic intersects at sharp angles. Four policemen are required, and still there are frequent accidents*



TRAFFIC ORDER

Figure 9: *The corner shown at the left has been equipped with beacons and three triangular areas. Safety is thus increased*

The Month In Medical Science

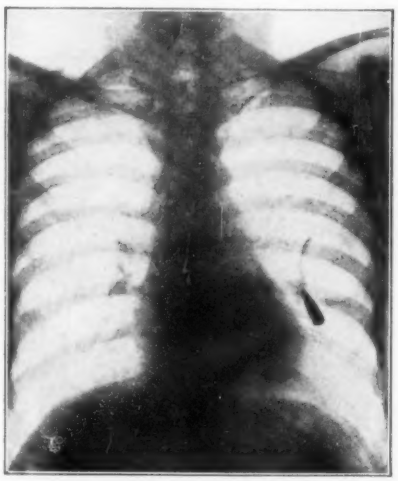
A Review and Commentary on Progress in the Medical and Surgical Field

By MORRIS FISHBEIN, M. D.
Editor of the Journal of the American Medical Association *and of* Hygeia

Sodium Nitrite Treatment of Seasickness

THE remedies for seasickness are almost as numerous as ships upon the sea. They vary from the old time "Mothersill's seasick remedy," which is essentially a sedative known as chloretone, to the use of tight bandages about the waist or cotton stuffed in the ears. Recently from two independent sources came the suggestion of a new remedy which it appears has been established as having merits.

Doctor Sellheim of Leningrad wrote to the *British Medical Journal* in February to the effect that he had found that single-drop doses of 1 percent solution of glycerol trinitrate (nitroglycerin) had kept one patient



THE BULLET

An X-ray photograph showing the position of the bullet in the lung of a war veteran

from becoming sick and that a woman who was extremely seasick while sailing on the Black Sea was able to take dinner 20 minutes after swallowing a small dose of nitroglycerin. Moreover, many other patients were protected from seasickness or cured of it by two drops of 0.5 solution of nitroglycerin placed on the tongue.

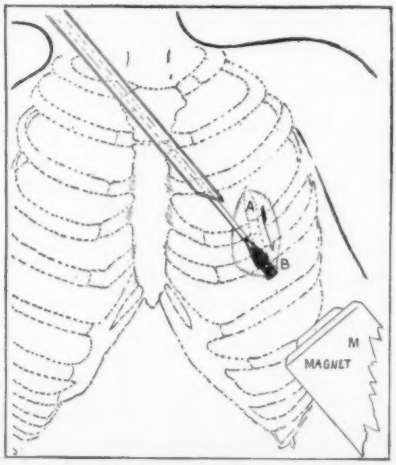
About the same time two investigators in the University of Chicago School of Medicine announced that they had worked out a system of control involving the use of sodium nitrite, a drug with the same effects as nitroglycerin. They had observed that a person who demonstrated the usual symptoms after twirling in a chair, the method used to test aviators, could be relieved of the condition by small doses of sodium nitrite.

One of the investigators tested the method on a trip returning from

BULLET DISPLACED

Bronchoscopic forceps caused displacement of the bullet to upper part of the cavity

Europe, when sixteen persons on the boat were seasick. Eight of the persons were given, every two hours, a dose of from three to five grains of sodium nitrite. The other eight were given merely the usual measures. Practically all of the persons who were given the nitrite were freed of their symptoms within four hours, and did not suffer from any recurrence of the symptoms. The method must, of course, be tested out on a much larger scale before its limitations can be accurately defined.



MAGNET IS USED

The magnet, M, was used to move the bullet from A to B where it was grasped by forceps

Removal of Bullet from Lung by Magnet

IN order to be affected by a magnet, a substance must be composed in part at least of magnetic iron, steel, nickel or cobalt. In the clinic of Chevalier Jackson in Philadelphia, 1900 inhaled or swallowed foreign substances have been removed from the air and food passages by modern scientific methods. These include chiefly the passage of an electrically lighted tube through the windpipe or the esophagus and the picking up of foreign substance by a specially devised forceps.

SIDE VIEW

Bullet was imbedded in an abscess cavity in the lung, and could not be reached readily

More than 90 percent of foreign bodies cannot be affected by a magnet. In a recent case a Canadian suffered severe symptoms from a wound sustained in 1918. An X-ray examination of the patient showed a bullet about one and one quarter inches long in the lung. A tube was inserted and passed through the main windpipe into one of the smaller branches, but the bullet could not be reached by forceps. Then a magnet was used over the outside wall of the chest by which the bullet was jerked down to a point where it could be reached with the forceps. Here by combination of two modern scientific methods the life of a veteran was saved.

Who Are the Mysterious

Many Scientists Believe that the Cultures of from the Old World by Oceanic Pacific in Canoes—

By A. HYATT
Museum of the American

PERHAPS RELATED

A Bogenahs Indian of Chiriqui, perhaps related to the bearded Indians of Bolivia

IN our last issue, Mr. Verrill told something of his explorations in South America, and of the tribe of bearded Indians found there. He also described the perils of travel in the jungles, and presented a thrilling word-picture of the dangers of water travel through the wilderness. In the following article he continues his discourse, giving his reasons for adhering to the diffusionist theory to account for the presence of the bearded Indians of South America.—*The Editor.*

PRACTICALLY everything that lives is food to the bearded Indians. Their menu is most varied and includes worms, grubs, insects, lizards, et cetera. Fire is made by rubbing two sticks together and is kept burning perpetually. Cooking is more of a name than a reality, and food is usually eaten half raw, in fact the rawer the better as long as the meat is dead.

Perhaps the most remarkable feature of the tribe is the fact that they have remained so totally distinct from all other tribes and have not apparently mixed with any other race. They appear to be completely isolated in customs, dialect and physical characters, the remnant of some primitive ancient race which has remained unchanged and at a complete standstill for countless thousands of years. In this respect they are much like the Bogenahs of northern Panama and the Bogsas of the interior of Brazil, both of whom are possibly common offshoots of the same race as that from which the bearded-Indian stock sprang.

Both the Bogenahs and Bogsas are small, almost pygmies in fact; both are exceedingly primitive, both live like beasts, subsisting upon anything that by the wildest stretch of imagination can be classed as food; both lack fixed homes or villages, and both are renowned for their ability to track game and to follow a trail by scent. Both of these tribes possess beards which are heavier than is usual among Indians, and the physical appearances of both are totally unlike other Indians.

IN both cases, also, they are surrounded by superior tribes who dominate them, and yet they have retained their peculiar characters so steadfastly and completely that instead of learning the dialects of their neighbors they have forced the latter to learn their own tongues in order to communicate with them. Moreover, the two are so similar in many ways that one cannot help feeling that they are closely related, although separated by thousands of miles, while the names Bogenah and Bogsa are phonetically so similar that they might well be local variations of the same word. At all events they are quite distinct from all other known races of Central and South America and in some respects seem to bear such a resemblance to the bearded Sirionos that they might well be offshoots of the same original stock.

All through the interior of Peru and Bolivia are many little known and interesting tribes who do not appear to be related to the better known Quichuas and Aimarás whose ancestors reached high stages of culture and civilization, culminating in the Incan Empire. Some of these possess the typical Indian characteristics facially and otherwise, while far more might well be natives of the South Seas.

The same holds true of the better-known Andean and desert tribes. Among the Aimarás and Quichuas individuals of the so-called Mongolian type are common, but by far the greater number are of the Oceanian type which would be exactly what we might expect if the original stock had migrated from some Pacific archipelago and later mixed with the more northerly tribes who may have come originally from central or southern Asia or might have wandered southward from the northwest where Mongol migrations are known to have taken place.

Even today it would be an easy matter for any large South Sea Island canoe or catamaran to cross the Pacific to South America. And we have no reason to think that at some time in the past there were not large archipelagoes in the Pacific which formed a series of oceanic stepping-stones from west to east. In fact, according to Dr. Thompson who made an exhaustive study of Easter Island, such an archipelago existed in comparatively modern times. It is not unreasonable to assume that the supposed subsidence of these long-lost islands forced the inhabitants to seek new homes in America.

THAT there was communication between the west coast of America and the Pacific islands has been indisputably established. In excavating prehistoric graves on the coast of California, expeditions from the Museum of the American Indian, Heye Foundation, found specimens of axe and adze heads from Hawaii and other mid-Pacific islands.

It was largely to search for traces of prehistoric cultures which might bear out this theory of an Oceanian origin of the South American races that I made my most recent expedition into the interior of Peru and Bolivia, for there, if anywhere, where ruins, graves and mum-

INDIAN WOMAN OF THE BRAZILIAN BORDER

She is weaving an apron of beads on a primitive loom which is placed in front of her. The art of weaving is widespread

Bearded Indians?—II

Central and South America Were Brought Invaders Who Crossed the South The "Diffusionist" Theory

VERRILL
Indian, Heye Foundation

mies of prehistoric peoples are so numerous and so perfectly preserved, one might expect to find such indications.

Although countless scientists and others have dug and delved among the ancient remains, and although innumerable works have been published in regard to them, yet the surface has not been scratched, and hundreds, even thousands, of ruined temples, forts, cities, buildings and cemeteries have never been studied nor have they even been seen by white men or, for that matter, by other natives. Here, hidden under the debris of ruined temples or palaces, or buried in the graves with the mummified dead, may lie the material which will set at rest all questions as to the origin, the identity and the history of the long-dead races who reached astounding heights of culture and civilization and vanished and were forgotten centuries before the coming of the Spaniards.

AT any moment most astonishing discoveries may be made which may completely upset our ideas of prehistoric man in America. Within the past three years two immense prehistoric cities have been discovered in Peru, close to the thriving port of Pisco and the sea, and my own discovery of an undreamed-of civilization of extreme antiquity in Panama was another proof of how little we really know of these early American races.

One of the main objects of my recent expedition was to compare certain remains of Peru and Bolivia with those of the Coclé culture of Panama. Much time was spent at Ollantaytambo, Machu-Picchu, Pisac, Viracocha, Rumiccola, Marcapata and Tiahuánaco.

The latter ruins, which are probably the oldest known in South America, are so strikingly like the Panama remains in many features that I feel convinced that they were the work of the same race or of races very closely related. The rows of huge, roughly-hewn stone columns are identical in arrangement and form.

SO too, are the alternate rows of stone images or idols, as well as the monolithic corner stones of the immense rectangular areas apparently used as temples. Certain figures and forms on ceramics and sculptures from the two localities are identical, and it seems scarcely reasonable to assume that two distinct races thousands of miles apart should have by chance developed so many features so amazingly similar.

In many respects, however, Tiahuánaco is totally different from anything yet found in Panama. In the latter country, as far as is known, there are none of the massive buildings composed of stupendous blocks of stone, some weighing over 100 tons, which are such a prominent feature of Tiahuánaco. Neither are there any of the monolithic square gateways or portals, nor the mathematically cut geometrical sculptures. But all of these might be due to environment or a higher development of the same culture.

Perhaps my most interesting find at Tiahuánaco was the discovery of two huge stone wheels, each over six feet in diameter and about 18 inches in thickness, and with centers pierced for axles. Hitherto it has always been thought that the wheel was unknown to American aborigines, and its absence has often been used as an argument in favor of the extreme antiquity of the races and as against their Asiatic origin. But if the stone wheels of Tiahuánaco were actually used as such, it disproves this assumption and also solves the mystery as to how these prehistoric people transported immense masses of stone for such long distances. Slung to axles between these huge wheels, whose thickness would prevent them from sinking into sand or earth, enormous blocks of stone could be transported for miles with little difficulty.

INDIAN AND BLOW GUN

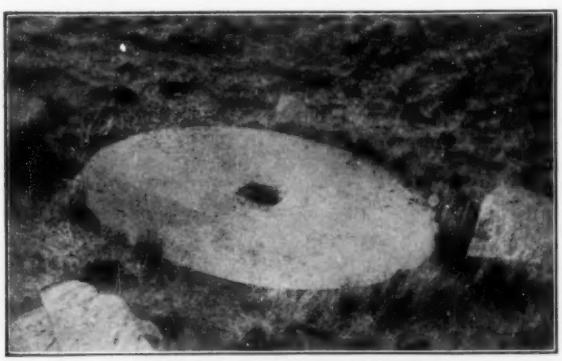
This is a forest Indian of a neighboring locality—not one of the bearded Indians

It may be argued that these wheels are not of prehistoric workmanship but are of Spanish origin and were used as mill wheels or *arastras*, but the evidence against this is very strong. I could find no records or traditions of Spanish mill-wheels used in the vicinity and I can hardly see why there should have been, as there is nothing, and as far as is known there never was anything, to be ground in the district about Tiahuánaco.

MOREOVER, it would have required a vast amount of labor for no reason whatever to have carried these huge stone disks up the hill to the ruins where they lie, one of them buried under the gigantic masses of fallen masonry.

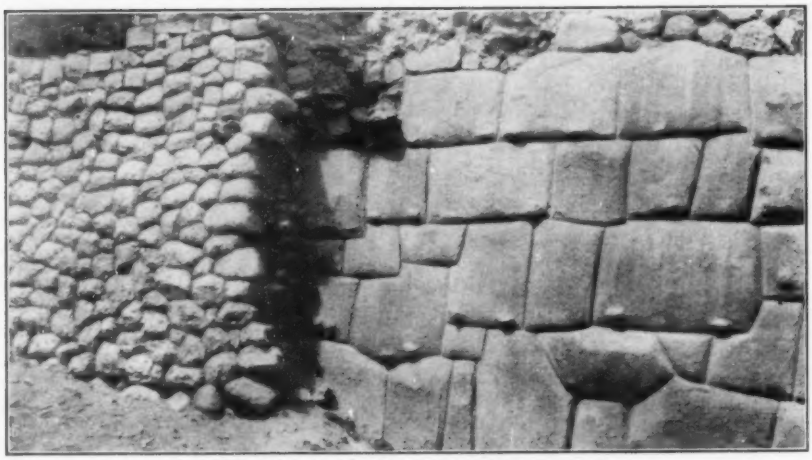
Finally, they appear to be of the same type of workmanship as the other cut stone work. Strangely enough, two similar stone wheels were found buried in the earth while excavating the Coclé ruins in Panama. At the time I dismissed these as being Spanish *arastras*, although there seemed no reason for a mill ever having been used in the arid non-mineralized district. But in view of those at Tiahuánaco I feel convinced that the stone disks at Coclé were also used as wheels for transporting the stone monoliths of the prehistoric race.

Unfortunately Tiahuánaco, which is one of the most interesting and scientifically valuable ruins in South Amer-



WAS THIS STONE DISK A WHEEL?

One of the strongest arguments against the diffusionist theory has been the fact that the wheel was unknown in the New World



PREHISTORIC WALLS AT CUZCO, PERU

The inner, pre-Incan wall is composed of blocks weighing several tons and, without cement, they fit to a knife blade's thickness. The outer wall is Incan work of poorer quality

ica, has been woefully and inexcusably destroyed by vandals, natives and government contractors. Tons of carved sculptures, images, columns and stonework were broken up to be used as filling for the railway bed. Innumerable portions of the finest worked and carved stone have been used by the natives for building their own miserable houses, and some of the most valuable portions and finest statues have been used as building material for the ugly Spanish church in the village. In addition, treasure seekers, souvenir hunters and vandals have dug, broken and destroyed on every side.

Still a vast amount of material remains intact and the largest ruins have never been thoroughly examined nor excavated. When the buildings were built the massive blocks of stone were all locked together by means of huge metal staples and bolts let into the stones. The beautifully cut grooves and holes which held these staples are still everywhere visible, but not a staple can be found in any of the blocks above the surface of the earth.

AN interesting discovery was that some if not all of these metal fastenings were of silver, for a native I met had one in his possession. No doubt the first Spaniards to find the ruins looted them of all the precious metal but the chances are that many of the blocks hidden beneath the accumulated debris of thousands of years still bear the massive silver staples that served to bind the stones together in the past.

In the district about Tiahuánaco, as in most of the trans-Andean and Andean regions of Bolivia, the Indians of the present day are Aimarás, whereas in Peru they are Quichuas. In both cases the races are divided into many subtribes with quite distinctive habits, cultures, arts and physical characters.

Such are the Collas of the Aimará race who inhabit the bleak mountain area on the eastern side of Lake Titicaca. Of all the Aimará tribes the Collas have been the least influenced by the white man's civilization and they still retain many of their own customs and arts. A very large collection was obtained from the Collas as well as from the Yungas, a tribe of totally distinct stock inhabiting the mild, fertile trans-Andean valleys between the mountains and the tropical forested area.

IN the Yungas district, even when beyond the outlying settlements and roads, traveling is by no means difficult, dangerous nor unpleasant. The country is delightful, the climate that of perpetual spring, and the Indians are clean, friendly and hospitable, with an abundance of cattle, sheep, poultry and vegetables.

But I have never experienced greater discomforts, nor have I suffered more from cold, than when in the district of the Collas. Here, at an altitude of from fourteen to fifteen thousand feet, one is constantly exposed to chill, biting winds blowing across more than 100 miles of perpetually ice-clad mountain peaks averaging over 20,000 feet in height. Blizzards are frequent, freezing rain falls without warning, sleet and hail come in blinding squalls, and even when the sun shines the temperature is scarcely above the freezing point.

The only accommodations are the miserable, filthy, vermin-infested hovels of the Indians—tiny, windowless huts of piled-up stones thatched with grass and inhabited by anywhere from three to six Indians and as many burros, pigs, fowls and flea-ridden curs. The only food obtainable from these Indians is crushed maize, a little hard wheat, frozen potatoes and occasional eggs or fowls. Sometimes one may secure air-dried strips of llama or bull meat which is as hard, rancid and tough as rawhide. Or if one happens to be near a lake or stream, wild ducks and snipe sometimes may be secured.

The only fuel is llama dung, and as water boils at a low temperature it is next to impossible to cook anything by boiling. To boil or roast food over a llama dung fire renders it inedible even to the Indians.

One cannot enquire too closely as to the ingredients of some of the weird dishes offered by the well-meaning Collas. On one occasion, after dining on a sort of stew which tasted unusually good, I learned that it was made of unborn llamas, while another time I made a good meal on cows' udders.

BUT despite all this, despite the bitter cold, the hardships, the lack of all comforts in this bleak land, it possesses its good points. The scenery is inexpressibly grand and magnificent, especially at sunset when the endless ranges of the highest Andes gleam in scarlet and purple and the vast glaciers are transformed to sheets of rose and gold. The Indians in their gaudy ponchos and bright colored mantas are colorful and picturesque. A herd of wild vicuñas, the fleetest-footed, most graceful creatures on earth, is a sight worth going far to see and there is much in the way of wild life to interest the naturalist at every turn. Majestic condors wheel constantly above the snow-capped peaks or perch on lofty pinnacles, viscachas gaze at the traveler from the mounds above their burrows: finches, larks, pipits and scores of other birds twitter and trill even at the verges of the snow fields, and big partridge-like gallinaceous birds whirr up from among the lava-strewn slopes.

Best of all perhaps, there are no insect pests. Neither flies, ticks, gnats nor mosquitoes exist in this cold, rarefied atmosphere, but personally, were I compelled to choose, I would take the steaming tropical jungles—rapids, ants, ticks and all, in preference to these bleak, wind-swept, frost-bitten heights.

BEAST OF BURDEN

Indian women do the work; the men are too fully occupied with important thoughts!

"Movie" Illusions—Their Creation

P and A

SOUTH SEA WAVES

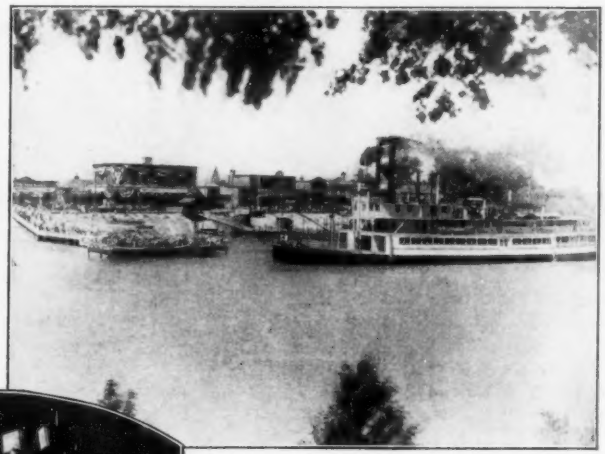
On the beach, off to the right, scenes in a South Sea island production are being enacted. Since this is being "shot" on the banks of the Los Angeles River where it passes the First National Studio, obviously waves were needed. A number of men juggle these see-saws, and wild, wild waves boom on the other shore

International Newsreel

SPIDERS GALORE

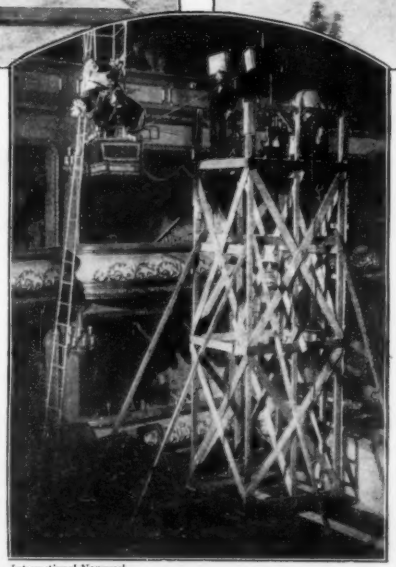
No, Aileen Pringle doesn't have a colony of pet spiders in a cage to make these filmy masses of webs for "haunted houses;" she's holding the mechanical spider which can cover a square foot of surface in a minute. Tiny streams of liquid rubber flow out, solidify in the air, and are blown by an electric fan

P and A



P and A

VIEWING a modern motion picture in the theater always found just around the corner, one often experiences a feeling of emotion mixed with a sense of puzzlement and wonder. The emotions engendered by the story as it flashes on the screen cannot down the desire to know how certain photographic effects are produced. We wonder about the storms—how they are made and where; whether the Sahara Desert, African jungles, the streets of Paris, or other scenes shown, are real or only "props;" or, perhaps, how the hero can survive the flames of a burning house or a dive from high cliffs. The photographs on this page illustrate some of the legitimate "tricks" of the "movie" makers which serve to indicate how other effects may be explained



International Newsreel

ON WITH THE DANCE

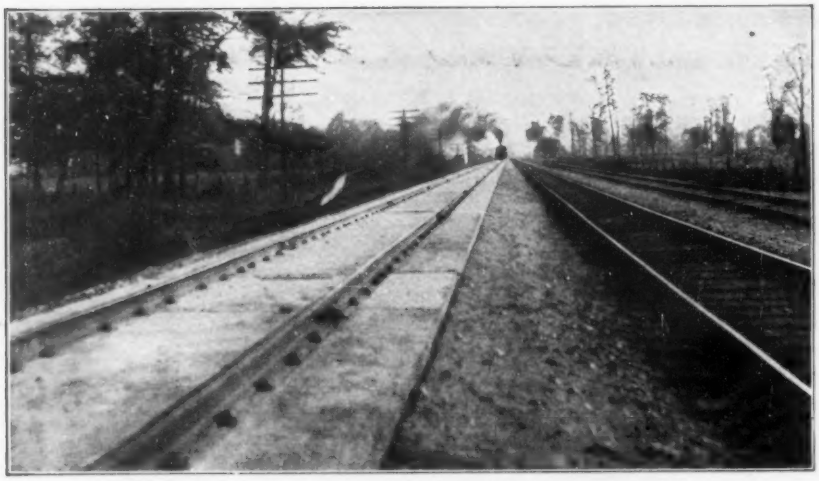
Left above: The director wanted to show us the facial expressions of Lloyd Hughes and Mary Astor as they danced about the floor, so this floor-level platform was built for dancers, camera, and lights

TOWN TO BE DESTROYED

Above: On a deserted bank of the Sacramento River this town, complete with stores, factories, warehouses, and a large population, was built to be destroyed by an airplane propeller cyclone—the climax to a Buster Keaton comedy

SLIDE, CLOWN, SLIDE

In "Laugh, Clown, Laugh," Lon Chaney makes a thrilling slide down a cable over the heads of a theater audience. This parallel tower was built to get action close-ups. Herbert Brenon is directing



FULL SPEED AHEAD OVER THE CONCRETE SECTION

When the section was placed in service, trains moved slowly, but speed restrictions were gradually modified, and finally removed altogether. Inspections were made at regular intervals

Is Concrete Better Than Cross-ties?

Test Section of Rigid Roadbed, Used a Year, Shows Superiority Over Ballasted Track

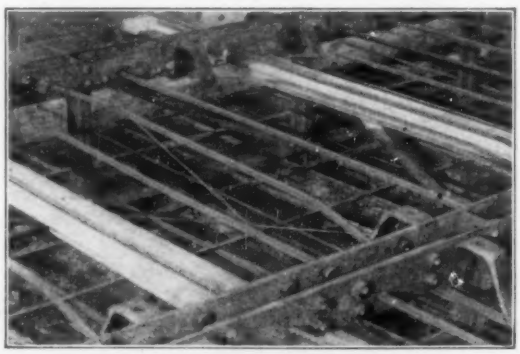
By F. D. McHUGH

THERE has been much discussion regarding the feasibility of supplanting wooden railroad cross-ties by concrete slabs and several experimental roadbeds of concrete have been constructed. Little success has been attained hitherto, however, and a great difference of opinion still exists among railroad men on this score.

Desirability of resilience was the argument to which opponents of a change tenaciously clung. To them, a concrete slab was out of the question: the train impact on a rigid roadbed would batter the rail flat; jarring would wreck rolling stock; and the noise would be unbearable. Then too, they said, frost and settling embankments would throw tracks out of alignment and destroy the foundation.

Now, however, a design for a rigid roadbed has not only been worked out to the last detail, but has been tried after actual construction for a year and found to be satisfactory. This experiment was carried out on a quarter-mile stretch of railroad on the Pere Marquette, following close study of the problem by Frank H. Alfred, the far-seeing president and general manager of this railroad.

The Pere Marquette's test section of concrete slab roadbed was finished in December, 1926. It is located at a point convenient for frequent observation, on a 0.1 percent grade between Detroit and Plymouth. At the time of its construction, the daily traffic on this track consisted of seven scheduled passenger trains, seven scheduled frieght trains, four regular switching movements, and about two extra freight trains. The heaviest locomotives used were of the Santa Fe type, weighing 321,000 pounds, 264,000 pounds of which is on five driver axles.



TRUSSES, CHORDS, STIRRUPS

All this steel-work is below surface of the concrete except the stirrups which extend above to hold the rail bolts

Thirty-four slabs, 39 feet long, 10 feet wide, and 21 inches thick, make up the quarter-mile section. Imbedded in the concrete, in addition to reinforcing rods, was a light fabricated steel truss under each rail. Brace frames and adjustable tie rods were connected between these trusses at intervals. The trusses were fabricated with upper longitudinal chords of one-quarter-inch by four-inch steel,

ASSEMBLING REINFORCEMENT

Trusses and reinforcing rods are being assembled here. The concrete mixer is shown

mounted vertically, to which steel stirrups were attached at intervals of 27 inches. The rails were fastened to these with clips and bolts, the rails resting directly on the concrete except for slight insulation which was necessary because of the block-signal system.

During the construction, all traffic was routed over the adjacent track. Ballast was removed only to the bottom of the old ties, thus making the concrete slab 15 inches higher than the parallel roadbed, incidentally allowing better drainage. Fabricated steel was then assembled, and alignment was assured by using transit and level. Concrete was prepared in a small mixer and delivered in concrete buggies. After flotation of the surface, the rail bearings were carefully troweled, and minor irregularities later removed by rubbing with carborundum bricks. The bed was then cured by keeping it covered with moist sand for seven days, and the first train ran over it three weeks after construction.

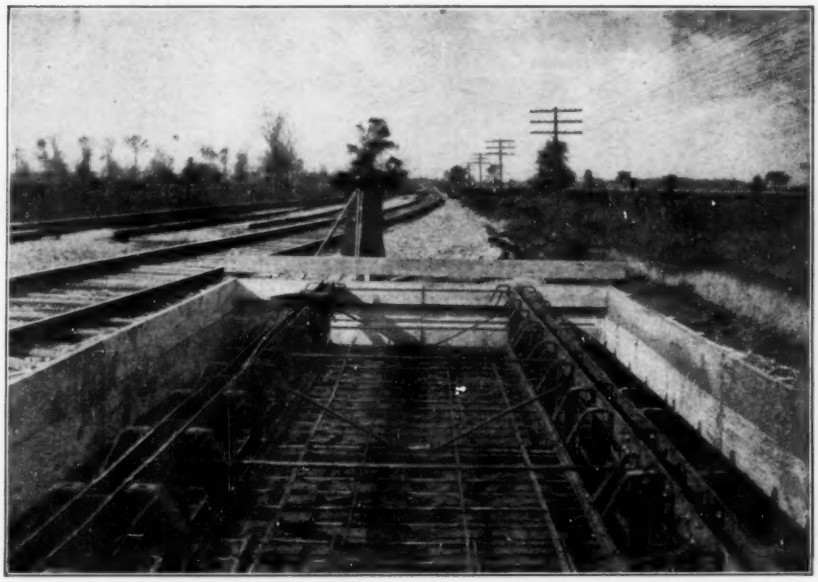
After a year's hard service, the concrete roadbed is in excellent condition, shows no disintegration, and the rails are not unduly battered. Levels have settled slightly but uniformly, and only four slabs have minute cracks.

Trains now ride as smoothly over the section as when it was built and, although the train noise is different from, it is no greater than, that made by a train on an ordinary track. There is no dust nor any click as wheels pass over a joint.

Paul Chipman, valuation engineer of the Pere Marquette, says in his report concerning this experiment, "One feature, the importance of which was realized when this section was built, has received added emphasis from our experience. This feature is the importance of having as close a contact as possible between the base of the rail and its support, and of maintaining this close contact by keeping the bolts, which fasten the rails to the roadbed, tight. It is important to reduce both vertical and lateral movement to the lowest possible limits." This statement, based on experience, nullifies the arguments of those who would place cushioning material between the rails and the slab on such a roadbed.

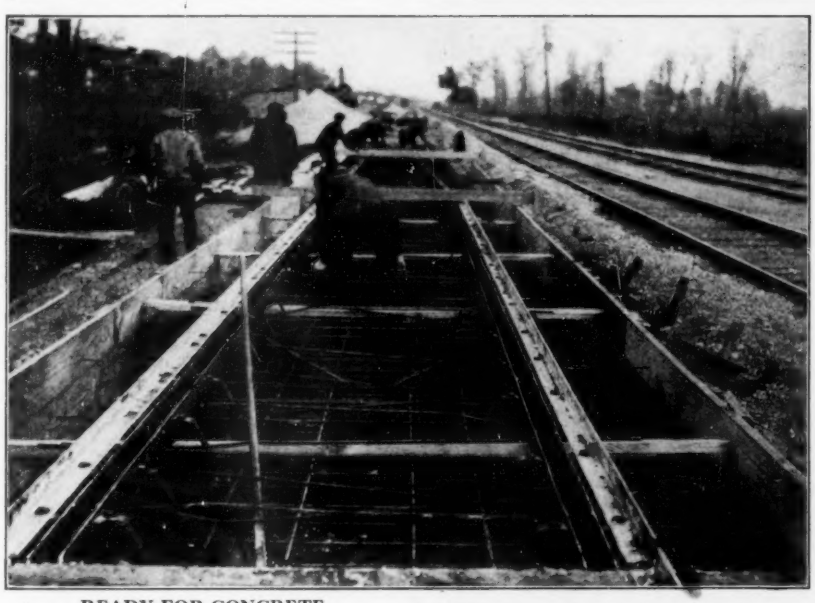
This test seems to have proved the practicability of a rigid roadbed. It has disproved the idea that hammering of rails would be excessive, and has shown that there is no wave motion in advance of a train. The initial cost of such roadbeds is not prohibitive and maintenance resolves itself into a periodic tightening of bolts and normal replacement of rails.

The success of this experiment augurs well for the future of the rigid roadbed and, in many quarters the opinion is that, after further tests, a design will be worked out that will be even more satisfactory. Simple reinforcing rods have been suggested in place of the fabricated steel, and other economies are expected in concrete. Less hammering may mean that smaller rails can be used, and elimination of wave motion may make faster schedules possible. Experience over a period of years only can answer these and other questions that remain, but one has been definitely settled, namely: resilience is unnecessary!



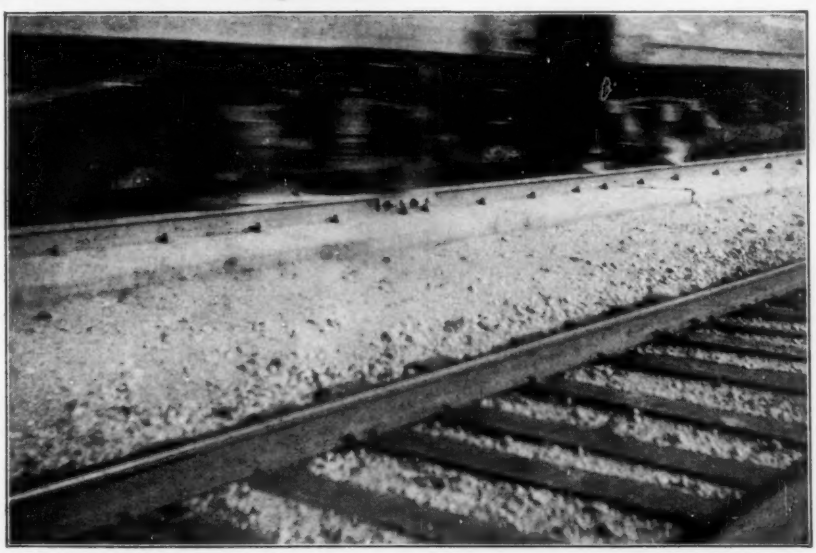
CHECKING ALIGNMENT

After all steel reinforcing had been assembled and the concrete forms had been erected ready for the pouring of concrete, a transit was used to check carefully the gage, alignment and level of the trusses and stirrups which hold the rails



READY FOR CONCRETE

Before pouring concrete on the assembled steel reinforcing, a three-inch by three-inch angle iron was bolted to the stirrups over each truss by means of clip bolts. These angles held the assembly in alignment while concrete was poured



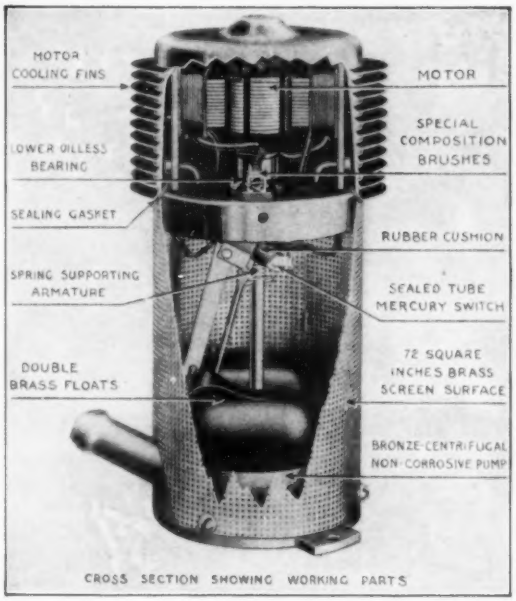
THE COMPLETED ROADBED

A freight train flashes by on the track with the permanent rigid roadbed. Although the train is going at high speed, it will be noted that there is no evidence of wave motion nor of hammering of roadbed or rail. Shock to rolling stock is, therefore, less than it is on a ballasted track

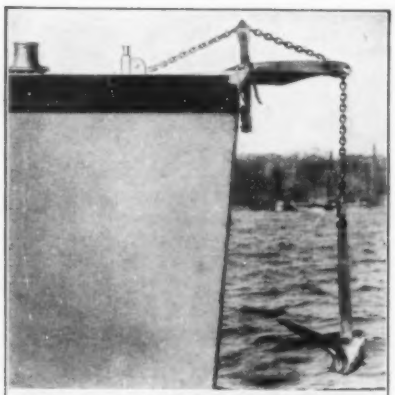
New Boats and Boat Equipment

FOLDING BOAT

This boat, which folds into a compact bundle 12 inches by 14 inches by five feet, is 10 feet, two inches long and three feet, six inches wide when opened. It is made of solid mahogany sections inside and out permanently in place with heavy waterproof canvas between. It can be assembled in less than two minutes without tools.—*Bair and Edgerton Boat Works, Glen Cove, N. Y.*



CROSS SECTION SHOWING WORKING PARTS

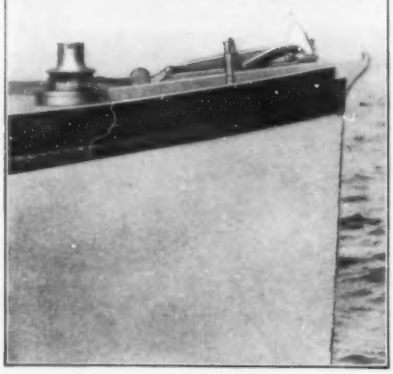


AUTOMATIC BILGE PUMP

Bilge water in a boat equipped with this pump, lifts the floats and starts a self-contained electric motor pump. Can be set to operate constantly or only as water rises. —*M. L. Oberdorfer Brass Company, Syracuse, New York*

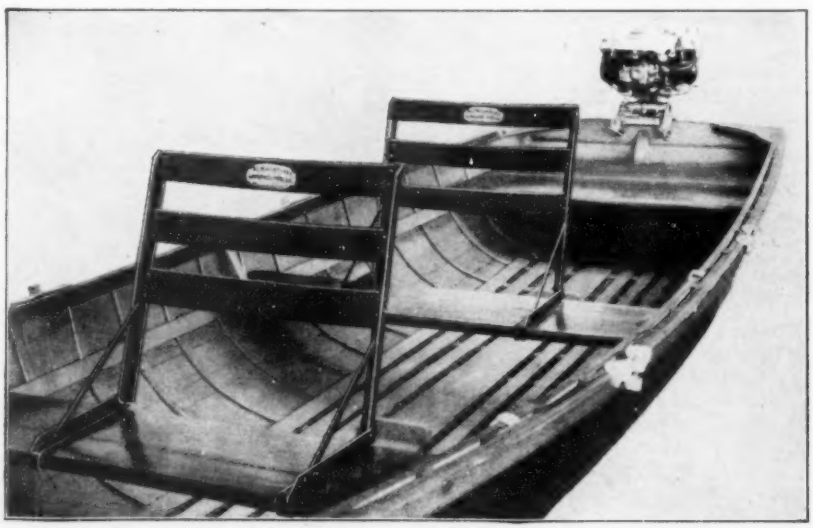
SEAT BACK

Made up entirely of steel, light and adjustable to the most comfortable angle, this folding, portable back rest will fit any standard boat seat. It can be firmly attached in half a minute.—*Warner Manufacturing Company, Minneapolis, Minn.*



ELECTRIC ANCHOR

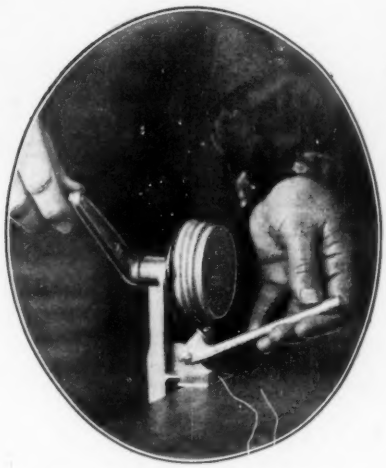
Two views of a new anchor which is operated by the touch of an electric button located near the tiller. When down, the anchor chain swings free of the bow on an arm; when up, arm folds back on deck. Requires little current. Can be operated with usual storage battery.—*Howard W. Lyon, Inc., 532 Lexington Ave., New York*

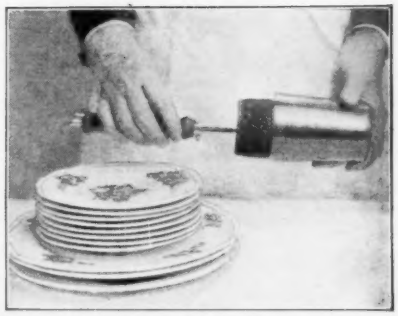


Household Inventions

DETACHABLE WRINGER

Suitable for the small apartment or home where but few things are laundered by the housewife, this new wringer can be attached to a small pail. It saves silky and filmy pieces that would be harmed by twisting. *—Lovell Manufacturing Co., Erie, Pa.*





DISH WASHER

The familiar rubber sponge has been given a handle and made into a dish washer. When a button is pressed, the handle is lengthened for washing deep glasses, fruit jars, and pitchers. *—Kristee Rubber Co., Akron, Ohio.*

CAP RIM SMOOTHER

By turning the crank which rotates the cap against the wheel on the lever as shown, it is possible to eliminate dents and nicks in the rim of jar caps, for better sealing.*—Hug Manufacturing Co., Ames, Iowa.*

WAX ELECTRIC CANDLE

The unique feature of this electrical candle is that it is made of real wax, the wires passing up through the center. The special lamp is made to resemble as nearly as possible the flame of an ordinary candle for its realistic effect.*—Art Kraft Fixture Co., 320 Adams St., Newark, N. J.*

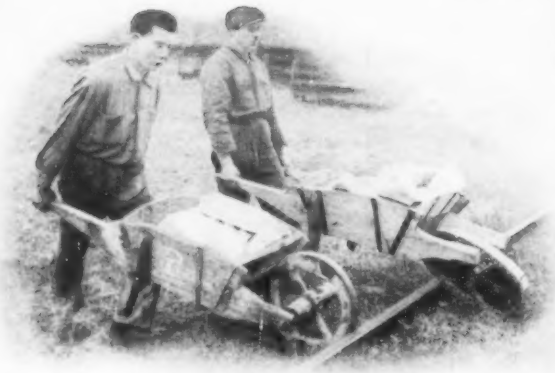
ILLUMINATED MIRROR

This mirror focuses a diffused yet concentrated light on the face of the user. It has a ball-and-socket joint so that it may be easily adjusted to any angle. It should be especially useful for the man who shaves himself or for milady's toilet.*—Bull Dog Floor Clip Co., Winterset, Iowa.*

MANY-IN-ONE NURSERY COMBINATION

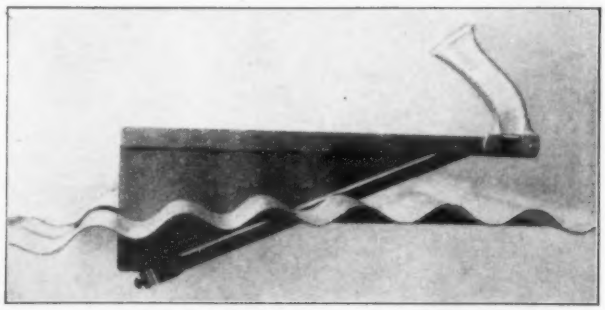
Here is everything the baby needs—crib, bath, dressing table, clothes drawer, toilet-ware cabinet, and indoor carriage. At the left: dressing table is placed over the filled tub which is made of rubberized fabric and may be folded. At the right: baby is strapped to dressing table, extended.*—The Nursry-Crafters, 1032 Jay St., Rochester, N. Y.*

Inventions New



TRACK-LAYING BARROW

A new English barrow which, like the fighting tank, has a wide, linked tread. It can easily be pushed over obstructions, through mud, or over irregular ground where an ordinary wheel-barrow is difficult to handle.—*Roadless Traction Limited, Gunnersbury House, Hounslow, Middlesex, England*

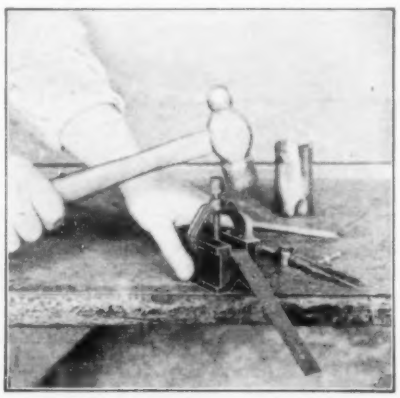


HACK-SAW FOR SHEET METAL

The end of the blade opposite the handle of this new hack-saw is held by a thin stiff blade of steel. The blade's angle allows hack-sawing of long sheets, regardless of width, where it would be impossible to do the job with any other saw.—*Arthur Collier, 453 Brixton Road, London, S.W. 9., England*

AUTOMOBILE ALTIMETER

With one of these neat instruments on the instrument board of his car, the driver can always tell at a glance how high he is above sea level. Can also be set to show the height of one place above another.—*Tycos Instrument Companies, Rochester, N. Y.*

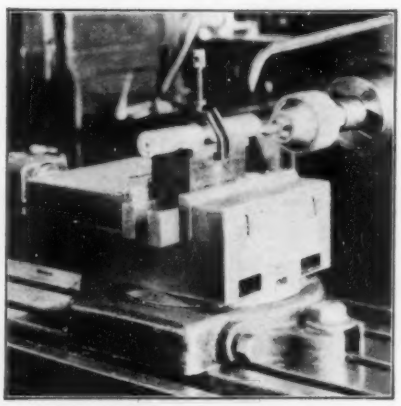


▲ HANDY BLOCK AND CLAMP

For home, work bench, or machine shop. In the illustration above, clamp and block are being used as a vise; below they assist in a difficult machining job.—*Browne and Sharpe Mfg. Company, Providence, R. I.* ▼

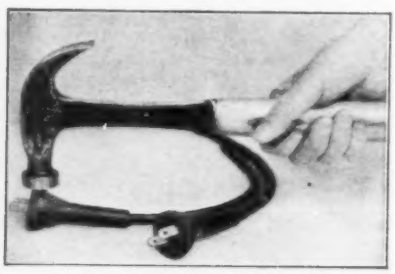
RUBBER GOLF TEE

Made of rubber, in the shape of a truncated cone, with each end hollowed out, this new tee is just the proper height for either iron or wood shots. It gives a good support and is so light that there is no resistance to follow through.—*Acushnet Process Company, New Bedford, Mass.*



◀ NEWSPAPER CLIPPER

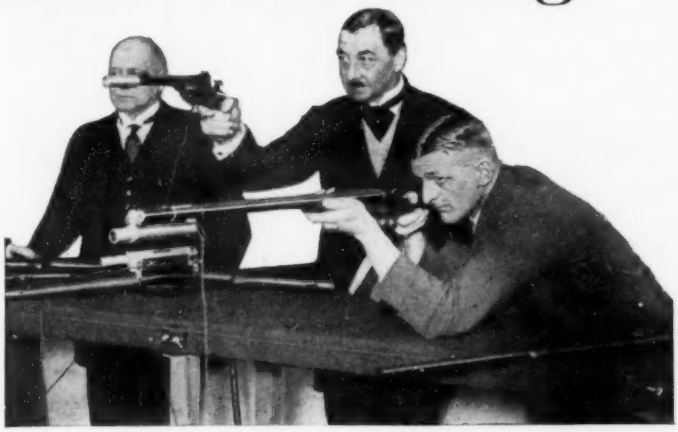
Essentially, a steel rod bent into a U, having the points tempered and sharpened to blades, this new device is a time-saver. A threaded rod between the legs, on one end of which is a thumb screw, allows adjustment of width.—*Roland Nunes, 18,000 Ventura Boulevard, Reseda, Cal.*



RUBBER PLUG-CONNECTOR

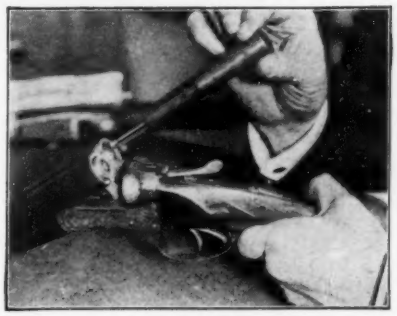
Bang it about, step on it, drop it, and still you cannot break this new connection which is made of solid soft rubber. It is extended in a convenient handle shape so that it can be pulled easily from any slotted plug socket, especially in narrow hanging shades. *The Belden Mfg. Company, 2300 S. Western Avenue, Chicago*

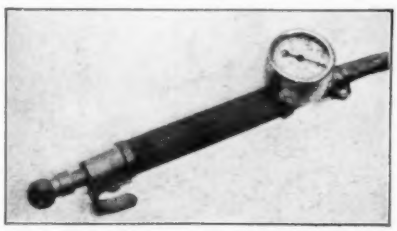
and Interesting



GUNS SHOOT SPOT-LIGHT

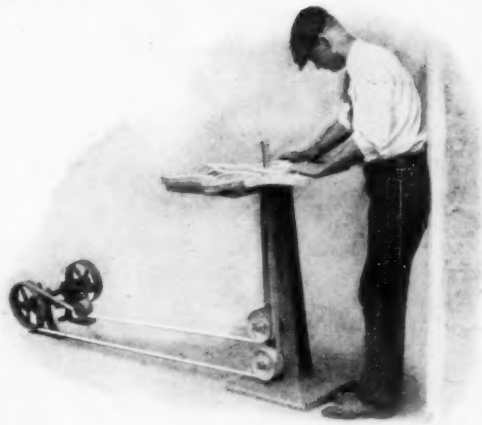
Invented by a retired English Brigadier General, this new instructional gun, which is made in several models, uses no bullets; when the trigger is pulled it simply throws a spot-light on the target. Since there is no recoil, the gun is expected to correct flinching. *Above:* several models are being used on an indoor range. *Right:* the electrical "cartridge" that makes the contact and flashes the light is being inserted in the breech of an ordinary gun.—*"Flash Spotter" Ltd., 217a Kensington High Street, London, W.8., Eng.*





TIRE HOSE GAGE

When the air chuck on the hose is placed on tire valve, the gage registers pressure of air in the tire. To inflate tire, the handle is pushed forward so that air may pass the gage. The tire air-pressure is tested by pulling the handle back.—*Specialty Manufacturers, Inc., Fort Myers, Fla.*

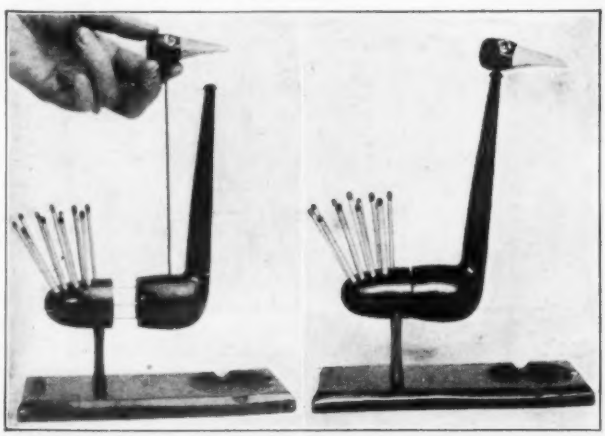


INSIDE SCROLL SANDER

This new sander gets into the corners of intricate patterns such as those cut by jig saw or router; it is adapted to inside or outside work. It has a 15 to 30-foot belt of sanded cloth which runs over a bracket above the table, and a set of pulleys.—*B and V Engineering Service, Shelbyville, Ind.*

EMERGENCY TIRE CHAINS

These tire chains are simple cross chains that snap around the tire and the wheel rim between the spokes. A special gripping arrangement makes it possible to pull out of the deepest mud and yet ride on pavements with but little bumping and cutting of the tires.—*Woodworth Specialties Co., Binghamton, N. Y.*



PIPE SET

This decorative duck is not only novel but also quite useful. The long wire holding the head is a pipe-stem cleaner; the pipe holder is a reamer for the bowl; the back holds a supply of matches; and the base is a neat ash tray.—*Stein and Ellbogen, Chicago*

UNIVERSAL VISE

This new vise, although screwed to a bench, may be adjusted to any position with a simple turn of the wrist so that the workman can see what he is doing. It has a ball-and-socket base.—*The Bel-Kel Mfg. Company, 740 E. North St., Decatur, Illinois*

California's First Oil Well Is Still Producing

Drilled in 1870, By the Spring-pole Method, the Well Still Yields About Four Barrels of Oil Daily

By HERBERT OTIS WARREN

THE enormous oil industry of California had its birth in Pico Canon, near the town of Newhall in Los Angeles County, in 1865, when Ramon Perea, a Mexican deer hunter, followed a trail to the head of the canon and came upon a seepage of sticky, black fluid that was unknown to him. Probably on the spur of curiosity, he gathered a small quantity of it in a canteen and returned to San Fernando to the Franciscan mission settlement.

Doctor Gelsich, a former resident in an oil-producing district of Pennsylvania, was given the canteen by J. L. Del Valle—to whom Perea had given the fluid—and he promptly declared the contents to be petroleum. He lost little time in forming a company and staking out placer claims covering the find under the then existing laws of California.

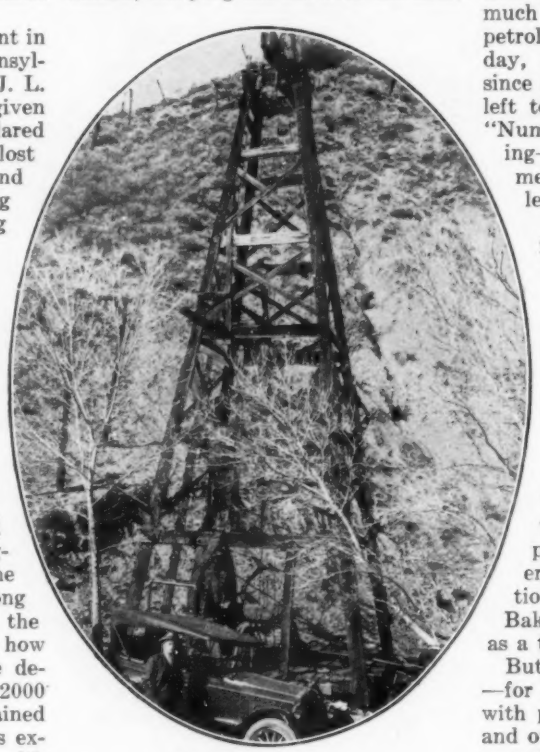
IT was nearly five years later, however, before a shallow well was drilled at the head of Pico Canon, by the old spring-pole method, and at the time of drilling, between 70 and 75 barrels of oil were produced a day.

The spring-pole system was originally used in digging brine-wells about a century ago, and was quite similar to the spring-board method practiced by the Chinese. The Chinese were among the earliest oil drillers—perhaps the first. History does not record just how many centuries ago these people developed their process, but for 2000 years—down to 1899—it had remained unchanged. Their apparatus was extremely crude when contrasted with modern well-drilling machinery, yet their methods were in principle strikingly like many scientific practices followed today.

The Chinese employed a cutting tool which was suspended in the hole by means of a stout rattan cable, and a spring-board arrangement—the workers giving it the necessary movement. When a coolie jumped upon the board it raised the bit, and when he relieved it of his weight the bit fell and cut its way downward.

A drum with a vertical shaft, around which oxen traveled in a circle, coiled the cable and lifted the drill out of the hole when it was desired to change tools or bail out the cuttings. The bailer was made of a section of bamboo, which tree also was used for casing, and for tubing and pipe-lines.

To return to the "spring-pole" process: A sapling 40 or 50 feet long was set at an angle of 30 degrees, with the upper end, to which a rope was attached, carrying the bit over the hole.



WELL NUMBER 4

As the well is today, after some 58 years of producing liquid riches for its owners

To give the tool its cutting action all that was necessary was to spring the pole up and down.

After completion of the well, C. A. Mentry was placed in charge of the work as manager and the Pacific Coast Oil Company was later formed.

It was not until 1879 that the first steam engine was brought into Pico Canon to replace the spring-pole well. This engine today is still on its original location and in good running order at "California Oil Works Company Well Number 4"—the name the state's first oil well is known by.

Twenty-three years ago the Standard Oil Company of California took over the well and production now averages four and one half barrels of oil a day.

Old "Number 4" is no Lakeview or Mayes. It has never startled the nation with its volume—it has not been much of a factor in California's great petroleum industry as we know it today, yet, while hundreds of wells since drilled have not even a derrick left to mark their one-time location, "Number 4" is still alive, still producing—a working monument commemorating the beginning of petroleum wells in the "Golden State."

Pico Canon is part of California's well-known oil district, Newhall fields, which include Wiley and Elsmere canons. To those not versed in oil locations, Pico Canon would appear to be barren of this rich fluid.

THE usual conception of a typical oil field is a district that resembles a flat waste of sage-brush covered desert, fringed by gently rolling hills. In such territory rock formations and exposed ledges are seldom encountered. This is perhaps a good description of the wells in and around Bakersfield where the land is as level as a table.

But this is not the case with Newhall—for here is rugged mountain country with precipitous canons, jagged rocks and overhanging ledges. It is truly a mountain-lion and eagle country—in fact, both were common there 40 years ago. The topography of the Newhall field is vividly suggested in the following abstract from a report of a geologist, Mr. S. H. Gester:

"The age and structure of the formations penetrated by the wells of the Pico and Wiley fields are the same. In fact, the sharp anticlinal fold, often found to be overturned and severely contorted, is continuous for more than eight miles, extending in a northwest southeast direction through both the Pico and Wiley fields. The strata

of this fold belong to a geological formation known as the 'Vaqueros' and are of lower-Miocene age. Because of the extreme sharpness of the fold, locations for productive wells are limited to a narrow belt along the apex of the anticline—a distance of 100 feet horizontally on either dip of the anticline will often necessitate a depth of 500 feet or more before the same sands can be reached by the drill."

The wells in the Elsmere field are started in a much younger formation than that of the other fields. In the first-named field the strata dip in more or less one direction and therefore the wells are not located in such an anticline structure as those of the Pico and Wiley fields. Some of the Elsmere wells undoubtedly produce from sands of a formation known as the Fernando, while deeper ones may also encounter underlying Vaqueros sands and produce oil from both formations.

Tracing the evolution of drilling equipment brings to light many improvements over the ancient spring-pole method of drilling. The radical departure in drilling methods came with the introduction of the rotary, invented in 1845, but not generally used until about 1900. Twelve years before this, however—in 1888—the rotary was used in the Gulf country. Two strings of pipe were used—one to wall up the hole, and the other, with the drill attached, was rotated inside of it.

IN 1889 it was discovered that a circulation of thick mud pumped through the drill-stem would support the walls of the hole until drilling was completed, in instances when the formation was favorable and the hole not too deep.

This discovery was credited to B. Andrews, Sr., of New Orleans, and is considered to be the most important step in the development of the rotary method. In 1901 Captain J. F. Lucas, drilling near Beaumont, Texas, completed the first oil well drilled by the rotary method.

Men in the oil fields sometimes refer to their companions who handle the rotary as "round-and-rounders," while those who are cable-tool workers are called "up-and-down-boys." And no clearer explanation can be offered than is contained in this slangy phraseology.

The development of the rotary did not supplant the cable tools, for today many wells employ both methods, and in the majority of cases both are utilized before a well is completed.

The home of the rotary was in the Texas and Louisiana fields where cast-iron rotaries were employed. California conditions—where deeper wells are bored—brought about a change in the rotary, and heavier and more powerful machines constructed of steel made their appearance in 1905. All rotaries were chain-driven until 1918, when a California manufacturer introduced the shaft-driven rotary.

Holes 20 inches in diameter are now started with a rotary—and the weight of the machine required to do this work is nearly three and a half tons. The complete rotary outfit used in the California oil fields weighs approximately fifty thousand pounds.

J. W. GALBRAITH AT NUMBER 4

At the age of 65, this old timer of the oil fields is about to retire. For the last 26 years, he has watched over the machinery of the well, and has well earned his vacation

California oil wells are noted for their depth, and to meet the requirements of the operators, what was known as the "California rig" was introduced. This instrument differs from those used in the east in that it is equipped with a "calf-wheel" for lowering and raising the casing in the hole. The eastern rig has no equipment for handling casing except for driving purposes.

It is truly a long jump from the earliest form of well-digging to the present day methods by which it is possible to take out 600 barrels or more of oil per day.

The trip to the site of the birthplace of the oil industry in California is an interesting one, although some of the road is rough and steep. At Newhall Pass, not far from "Number 4" may be seen an ancient cut through which the old roadway ran. This was known as the Fremont Pass in early California days, and it was over this route that General Fremont came and conquered the Mexican forces then in Los Angeles. The cut is 65 feet deep, and but a few feet wider at the top than at the bottom, where there is room for but one automobile to pass at a time.

One of the men who has watched "Number 4" for 26 years can be found on the lease today. He is J. W. Galbraith, 65-year-old, robust, oil man. He stated that the well has been averaging as good as any on the lease—and the hillsides of Pico Canon are dotted with derricks, the pumps of which are operated from a central power house near the oil well.

Galbraith plans to retire soon and move out into the valley after nearly half a lifetime of daily effort shut in by the hills from any extensive view of the outside country.

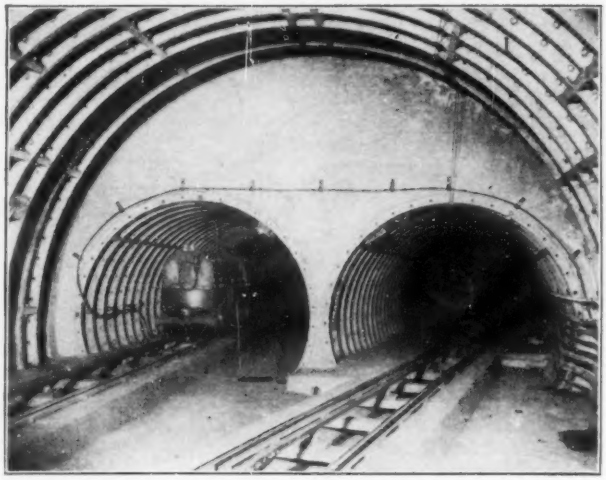
That old "Number 4" enjoys a unique position among California oil wells is attested by the fact that more than one million barrels of oil have been taken from the well since 1870.

¶ *Traces of an ancient civilization in the southwestern part of the United States have been found along the Mimbres River in New Mexico. Be sure to read the details of the discoveries which will appear in a near future issue.*

London's New Post-office Subway

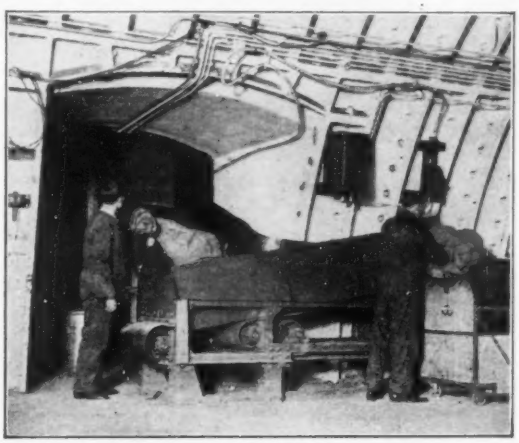
TRAIN CONTROL BOARD

London's newest railway, recently placed in service, is a subway for carrying mail between Whitechapel in the eastern part of the city and Paddington in the western part. Built primarily for accelerating the conveyance of letters and parcels through the city, it is the result of plans considered as long ago as 1909. The trains, consisting of one to three cars, each capable of carrying 1120 pounds, are driverless, operation being effected from switch cabins at each station. The tunnel is 50 to 90 feet below the surface. Each station has spiral chutes for carrying mail down, and elevators for carrying it up. From the switchboard shown above, all trains in Mount Pleasant division are controlled. Above the operator is an illuminated diagram board which shows location of trains on all tracks of the division he controls



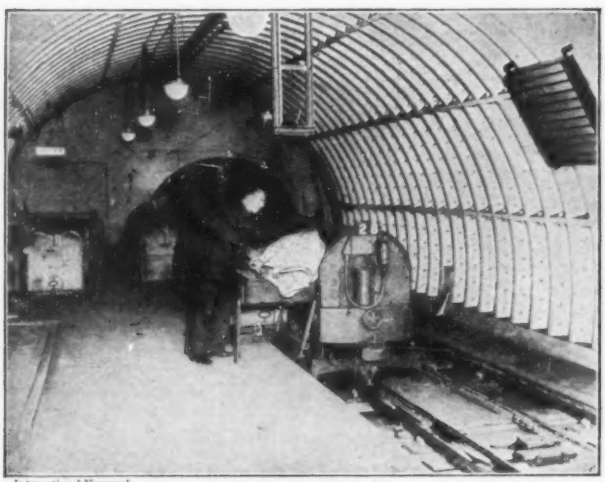
TUBE JUNCTION

View of the junction of two tubes near the Mount Pleasant post-office. Total length of this system is six and one half miles, but it is planned to extend it until ultimately it will form a net-work throughout the city. Its operation is relatively simple: mail bags are loaded on the trains at the General Post-office and Mount Pleasant and then routed to the various post-offices along the line in the driverless cars. The relief that this railway will afford to street traffic will be appreciated when it is considered that 750 tons of mail must be handled daily, and that this railway is capable of making approximately 800 train journeys a day, carrying a total load of 23,000 bags, at an average speed of 20 miles an hour in contrast to five to seven miles per hour by surface carriers. This railway is the first of its kind



BAG CHUTE

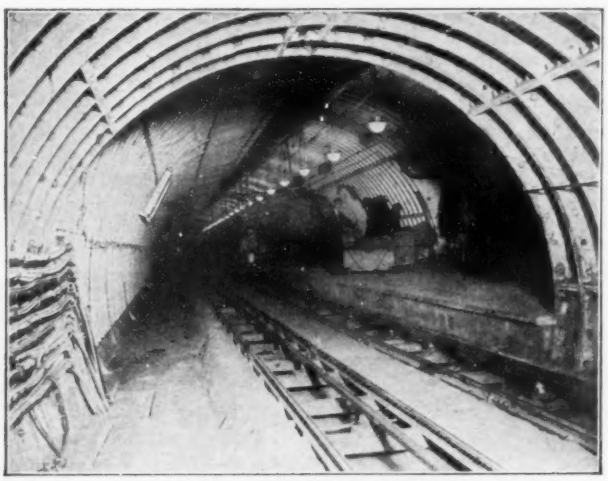
From the post-office above ground, mail bags are conveyed by this chute to the station platform below. To prevent their piling up, a conveyor belt is utilized to carry them to a truck-loading table



International Newsreel

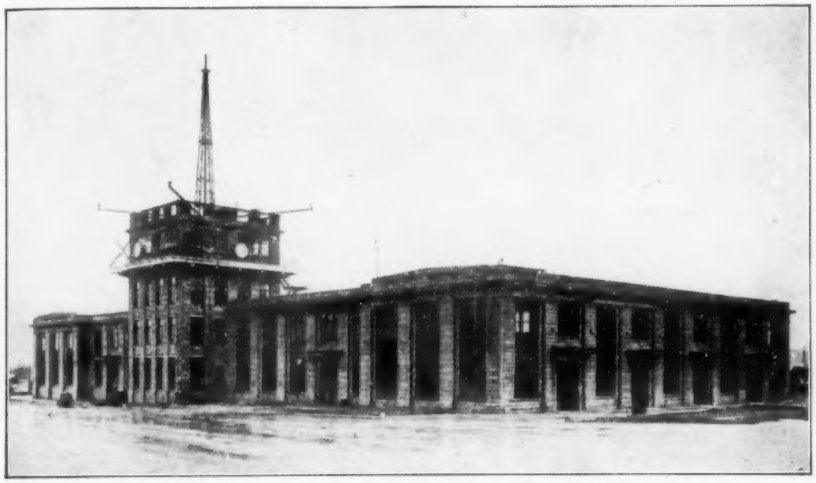
LOADING A TRAIN

Hand trucks carry the mail bags about the platform after they are loaded at the chute. It is expected that this system will effect a saving of about 200,000 dollars annually



MOUNT PLEASANT STATION

All stations were provided with through (express) tracks in addition to platform tracks. Reversing loops were laid out at most stations and the more important ones also have sidings



RADIO CONTROL BUILDING AT CROYDON AIRPORT

The control apparatus of the transmitter, and the receiving instruments are located in the tower, directly under the mast which supports the double triangular direction-finding aerials

"Passing Boulogne!"

Huge Radio Station at Croydon Serves British Airways

By A. P. PECK

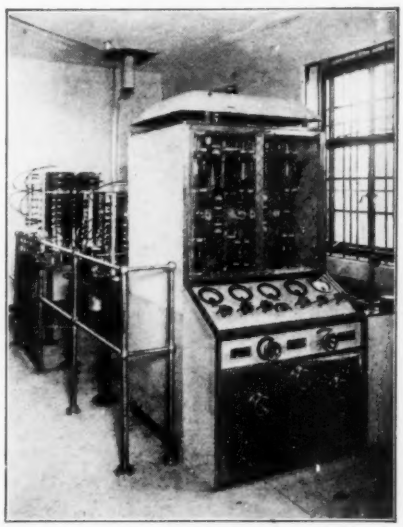
"IMPERIAL *G-BOZ* calling. Imperial *G-BOZ* calling. Passing Boulogne. Passing Boulogne. Over." And the radio operator at England's huge airport and radio station knows that the airplane *G-BOZ* has safely crossed the channel and is passing into the flying zone which is under the control of the French.

The Croydon airport is notable not only for the highly efficient and modern equipment for handling aircraft, but also for its complete radio installations, some views of which are reproduced on this page. By means of these, the passage of planes over the regular air-transport routes can be followed as accurately as are the trains on a railroad system. All of the regular passenger planes flying from Croydon are equipped with radio transmitting and receiving apparatus by means of which they can keep in constant communication with the terminal.

The quoted sentences in the first paragraph above serve to illustrate how the radio operator on a plane reports the plane's position to the airport. "Over" means operator is ready to receive. Upon receipt of the information, a map in the office of the Chief Aerodrome Officer is corrected so that, at any time, the positions of the various planes can be seen at a glance. Tiny metallic planes are held on the map by magnetic attraction.

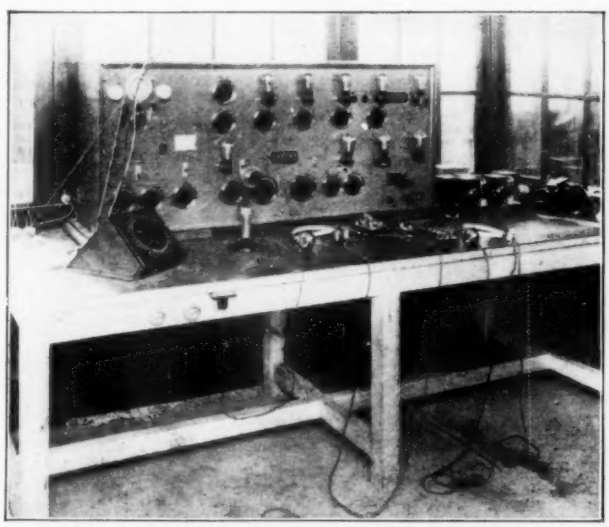
Although the receiving aerials for regular reception and for direction finding are located at the airport proper, those employed for transmitting are at a point about four miles distant, at Mitcham, so that the tall towers necessary for efficient work will not be a source of danger to the planes.

It is reported that there will be 50 planes a day arriving at or leaving this great terminal airport at Croydon during the coming season.



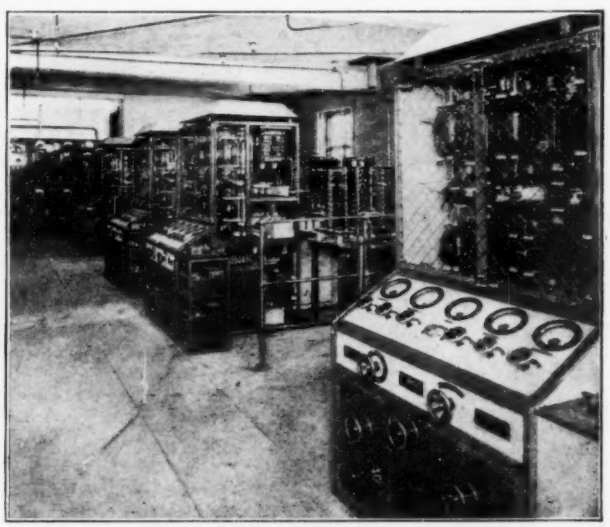
TRANSMITTER

One of the four remote-controlled Marconi three-kilowatt transmitters located at Mitcham



TRANSMITTER CONTROL AND RECEIVER

The huge cabinet at the rear of the table houses the receiving equipment. In front of it are the microphone and code transmitting key



INTERIOR OF BUILDING AT MITCHAM

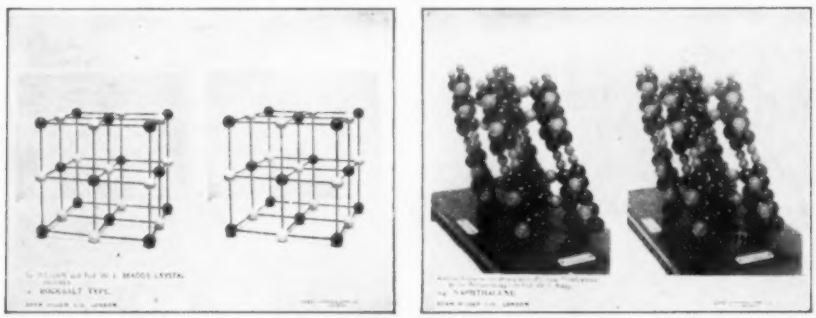
Here are shown all four of the powerful transmitters, one of which is illustrated in more complete detail in the column directly above

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Visualizing Atomic Structures

THE editors have received from England a most fascinating scientific plaything—a pocket stereoscope and a set of 37 double, stereoscopic photographs of crystal models showing the atomic structure of the substance viewed. We term this interesting little apparatus a "plaything" because we have ourselves enjoyed it, and admittedly there is often a close connection between the scientist and the play instinct: the scientist is naive, as a rule. However, the real purpose of this stereoscope is for the elucidation of atomic structure.



Atomic structures. Try to see these stereoscopically. Text tells how

Diagrams are plentiful, depicting the arrangement of atoms in crystals (and since the technique of X-ray analysis of crystals has been developed it has become apparent that nearly all forms of matter are crystalline) but all diagrams and drawings fall short of the reality because the reality exists in three dimensions, while it is possible to represent accurately on paper only two dimensions. Models having three dimensions are to be had, but they are expensive and bulky. Here the common stereoscope enters the field.

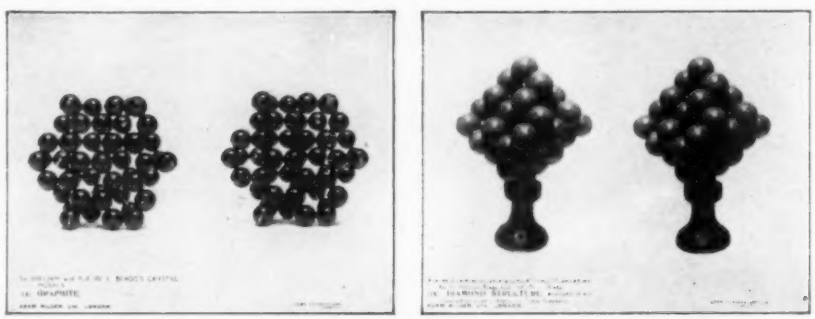
Most of us recall the stereoscope. As lads we spent what was considered in those days an almost sinful Sunday afternoon gazing through a wooden contraption at what appeared to be duplicate pictures of Niagara Falls, Yosemite Park, or perhaps a daring picture of a bold lady holding her skirts half way to her shoetops. All these pictures, when thus viewed, at once took on a solid, three-dimensional illusion.

Adam Hilger, Ltd., London, has reduced this clumsy apparatus to folding cigarette-case size. Seen through it, the various double photographs of crystal models stand out fully in three dimensions. This facilitates the study of them, for those who are interested in this scientific work. It is interesting, however, to discover that after a little practice one may learn to see double pictures such as those reproduced in these colums without the aid of a stereoscope. This is learned by holding the picture at normal sight distance, and looking over the top of it at some distant object. Without altering the eye focus, the two pictures may now be brought into coincidence, when they will suddenly leap out of the page. It strains the eyes but the effect is somewhat startling.

While no one knows yet what an atom would actually look like if seen (optical paradox), enough is known to permit us to arrange with utmost precision the component atoms of a crystal unit. The balls which are commonly employed to represent the atoms in crystal models are regarded only nominally as atoms; they merely stand for the atom, whatever its exact nature is supposed to be. The arrangement, however, is correct beyond doubt.

The first stereographic photograph here reproduced is a simple one—rock salt. The second is naphthalene, the model showing the mutual arrangement of ten molecules, eight of which are alike in orientation and are placed at the eight corners of the fundamental cell; the other two are derived by rotation through 180° about a diagonal.

It is possible to measure accurately with modern X-ray crystal analysis apparatus the dimensions of the unit cell of a crystal.



More about atoms—be sure to read the article on page 9 of this issue

For example, the three dimensions in the naphthalene cell are respectively 8.34, 6.05, and 8.69 Angstrom units, an Angstrom unit being one 10,000,000th of a millimeter or about one 250,000,000th of an inch. This is close measuring.

The remaining two models contrast graphite and diamond—two forms of the same element. Why is diamond a hard cutting agent and graphite a soft lubricant? The models explain it: in the diamond the tetrahedral arrangement is such that each atom is *locked* to four other atoms; but in the graphite the atoms are arranged in separate layers which slide easily on one another. This explains why it is as unlucky to step on graphite as it is to step on a banana peel, for the layer of graphite atoms which sticks to the sole of the shoe and the layer which sticks to the floor do not stick together. Hence the foot flies upward and the salient parts of the anatomy hasten downward.

The stereoscopic photographs were all edited by Sir William and Professor W. L. Bragg, the famous authorities on X-ray crystal analysis.

Tall Buildings Protect Neighbors From Lightning

TALL buildings and lightning rods mounted on high towers protect neighboring structures from lightning, provided they are not so high as to extend out of the cone of protection. This protected area extends around the base of the high building for a distance of between two and four times its height. Imaginary lines drawn from the top of the building to the edge of the protected area define the protected cone, says F. W. Peek, Jr., who is in charge of the General Electric Company's high voltage investigations at its laboratory at Pittsfield, Massachusetts.

Mr. Peek's investigations have been made with artificial lightning at pressures of as high as three and a half million volts. These man-made flashes have been used on small models of buildings. However, confirmation of his discoveries was obtained by studying a natural electrical storm that occurred in New York last summer, and during which the New York World Building was struck. Although this building is close to the Woolworth Tower, and is in the 1100-foot circle around its base that is protected, the dome of the World Building extends for about a hundred feet outside the cone, and that is the reason it was struck, explains Mr. Peek. If it had been 200 feet closer to the Woolworth building, it would have been protected.

Practical application of these experi-

A SMALLER, SMARTER . . . AND HUSKIER . . . *ELGIN*

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Model 303. Cased by Elgin in chromium plated nickel. Will not tarnish or discolor. Handsomely engraved. With raised figured dial, $19.00. Luminous hands and dot dial . . . . . $20.00. With luminous dial and hands $21.50

Model 302. Cased by Elgin in chromium plated nickel. Handsomely engraved. Extra heavy crystal. With luminous dial and hands, $21.50. With luminous hands and dot dial . . . $20.00. With raised figured dial $19.00

Model 301. White or green gold-filled case that carries full guarantee of the Elgin National Watch Company. With raised figured dial, $25.00. With luminous hands and dot dial, $26.00. With luminous dial and hands $27.50

Model 300. White or green gold-filled case that carries full guarantee of the Elgin National Watch Company. With luminous dial and hands, $27.50. With luminous hands and dot dial, $26.00. With raised figured dial $25.00

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ments, says Mr. Peek, has already been made in California, in safeguarding oil storage tanks from lightning. Several tall rods, placed outside the big reservoirs, provide overlapping cones of protection and reduce the danger to a minimum.—*Science Service.*

Tornado-Resistant Buildings Possible

STRUCTURAL damage to buildings by tornadoes and the loss of life incident thereto, may be avoided or reduced by designing buildings so that they can more readily resist internal pressure, de-

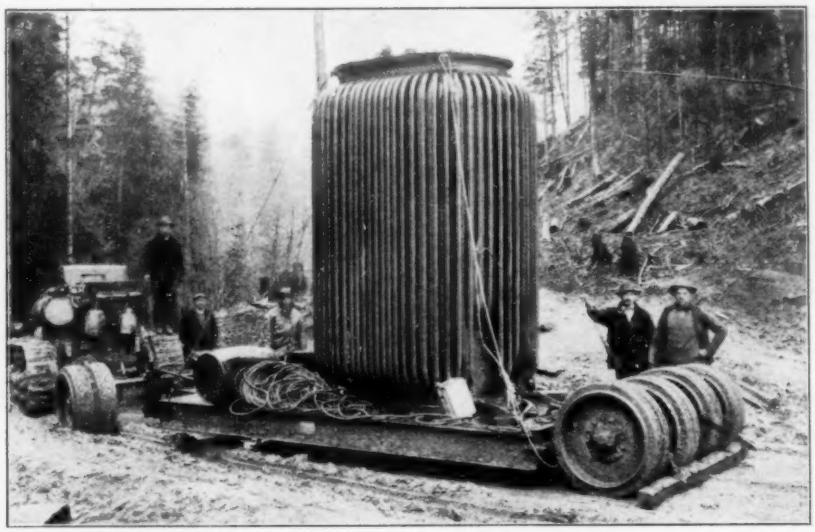
Air confined behind brick veneer and in the unlined chimneys, caused the face brick to peel off when a tornado passed by

clares L. V. Teesdale, of the United States Forest Products Laboratory.

Property damage to buildings by tornadoes may be divided into two classes —that caused by the explosive effect and that caused by flying debris. The explosive effect, usually the more serious, occurs as a result of a difference in atmospheric pressure set up by a tornado between the inside and the outside of a building. The sudden drop in external air pressure produces an internal pressure which frequently results in the blowing out of some portion of the building.

"It is possible to relieve the internal pressure of air thus set up in a building by providing automatic vents in it," says Mr. Teesdale. "Observations made following the St. Louis tornado last September indicate that from 10 to 15 percent of the outside walls and a similar area in the roof should be vented. There are a number of methods by which this could be done. If a sufficient number of windows or panels were designed so that they would open outward from internal pressure the necessary venting could be accomplished. Special windows equipped with hardware which would work on the same principle as the panic bolts used on exit doors in theaters would do the trick. Hinged panels for use in the spaces between windowsills and floors or elsewhere in the side walls of a building is another venting possibility. Roofs may be vented by automatic dormer windows, by special skylights, or by hinged roof panels arranged to swing outward.

"Such automatic vents could be installed in existing buildings as well as in new buildings. They could be used in all types of buildings, large or small, public or private, in the city or in the country—even to the farmer's barn or poultry house. The practicability of various venting methods could be tested in laboratories. This would offer opportunity to work out the most suitable types of vent construction."



Heavy screw jacks between wheels made possible the lowering of the truck for passing under bridges. Note the timber dragged behind the wheels

One side wall of this house sprang outward at the second floor, but the building remained structurally intact. The frame house is over 60 years old

Twenty-five Ton Transformer Hauled on Six-wheel Trailer

IN hauling three 25-ton transformers for the Glines Canyon hydro-electric development on the Elwha River of the Northwestern Power and Light Company, Port Angeles, Washington, a six-wheel trailer towed by a tractor was used, the trailer being adapted and equipped with built-in screw jacks at each set of wheels for lowering the trailer bed. In order to get the transformers through one bridge in particular, it was necessary to so manipulate the screw jacks that the bed practically touched the ground. In order to supplement the brakes on the tractor and on the trailer, a piece of timber about four inches square was attached to chains and dragged just behind the four rear wheels of the trailer. This kept the load from running backwards down hill in case it became necessary to stop on an upgrade.

Each transformer was six feet, three inches by eight feet, four inches, and 12 feet, five inches high. Four cables were used to fasten the transformer rigidly to the bed of the trailer to prevent the high load from tipping over.

North Light Is Blue---Not White

SCIENCE has cast another tradition into the ash heap. North sky light, long accepted by artists, engineers, housewives and store clerks as the perfect standard of white light for examining colors, has been found to vary in intensity and color, not only from day to day, but also from hour to hour.

The American Institute of Electrical

The new trolley truck with the hydraulic tower in the elevated position. The body of the truck can be used for carrying auxiliary equipment

Engineers is responsible for the latest upset. North sky light is not white, but blue, it was found, and examination of colors under such light exaggerates blues and minimizes reds and yellows. The engineers declare that noon sunlight and not north sky light should be accepted as the standard, and that artificial white light for color discrimination purposes should approximate noon sunlight.—*Science Service.*

Hydraulic Trolley-Tower Truck

A NEW and easy way to reach street lights and overhead wires is afforded by a hydraulic hoist mounted on a two-ton Graham Brothers truck which has a 162-inch wheelbase. The principles involved in the raising and lowering of the working tower are the same as those employed in the hydraulically operated dumping truck.

The tower is built and installed by the Wood Hydraulic Hoist and Body Company, Detroit, and consists of a rigidly constructed platform with hinged double guard railings with steel brace rods, piston and cylinder gear-driven pump, and transmission power take-off. The cylinder is seven inches in diameter with a one-half inch wall; diameter of the hollow piston rod is five inches.

The working platform is nine feet long and four feet wide and is arranged to swivel and lock securely in any desired position. It is fastened to the top of the piston rod by a heavy collar and held and braced by a ribbed steel plate four feet square. When in lowered position the top surface of the platform is eight feet, six inches from the top of the chassis frame. When in fully elevated position it is 14 feet, seven inches from the top of the chassis frame. Full elevation is obtained in approximately 50 seconds. Platform can be locked securely at any intermediate elevated point required. Space required back of cab for hoist mounting is 14 inches. The distance from ground to working platform when it is fully elevated is approximately 16 feet.

The public utility body is built and installed by the Proctor-Keefe Company of Detroit, Michigan.

Largest Railroad Oil Reservoir

THE largest oil storage reservoir ever built by a railroad company, and one of the largest oil containers in the world, has recently been completed by the Southern Pacific in California.

The reservoir has a capacity of 3,000,000 barrels, and is intended to hold a reserve supply of fuel oil for the Company's oil-burning equipment. It is strategically located both with regard to source of oil supply and convenient shipping facilities. Within half a mile are the pipe lines of two of California's largest oil companies, to either of which the reservoir filling pipes can be connected, and the same lines are to be utilized for delivery to the railroad's tank car loading rack near Tracy.

The reservoir is 1085 feet in length, and 490 feet in width, inside the walls, with a depth of 31 feet.

World's Finest Wire Cloth

A WORLD'S record has been established by the Newark Wire Cloth Company of Newark, New Jersey, by making a wire cloth having 160,000 square openings per square inch. It is the finest wire cloth ever made. In other words, it is a "400-mesh" wire cloth with 400 parallel wires per inch of width running each way, at right angles. A piece of the wire cloth slightly more than six square inches in area, or, to be exact, a piece only two and one half inches square, has one million *square* microscopic openings.

Heretofore the finest wire cloth ever made in the United States has been 325 mesh and it, too, is made by the same company. It is known as Sieve Number 325 by the United States Bureau of Standards, and has been adopted as standard by the American Society of Testing Materials. Such fine wire cloth is used principally in the manufacture of testing sieves for the cement industry or others of a like nature.

Ordinary fine wire is not fine enough for 400-mesh wire cloth. It has not the necessary quality—the correct temper—

Southern Pacific Photo Service

Interior of the new 3,000,000-gallon oil storage reservoir built by the Southern Pacific Railroad. Floor was first completed, and then the entire reservoir was covered

General view of the huge reservoir which is to hold a reserve supply of fuel for the railroad. Standing as it does in a great field, it seems more like a fort of dirt

the required uniformity. The Newark Wire Cloth Company has found it necessary for many years to draw all of its own fine wire, and of course it was an absolute requisite for them to draw the wire for this 400-mesh cloth themselves.

Some 10 years ago the United States Bureau of Standards in their investigation of testing screens, said that it seemed impossible for American manufacturers successfully to manufacture wire cloth with meshes finer than 100 to the inch, and that wire cloth with finer meshes had to be imported. For a long time previous to this, all of the fine wire cloth on sale in the United States came from foreign countries. At that time 325 mesh was the finest made, and 250 mesh was the finest produced in the United States.

Quenching Fires by Catalysis

AFTER man, centuries ago, found he could produce heat and fire by rubbing two sticks together, he immediately had to find ways and means of subduing the monster he had loosed. For while fire gave him heat, it was also very destructive if it got out of his control.

Since then man has "drowned" or "smothered" fires almost universally. In the first method of drowning, water is thrown on the flames to reduce the temperature of the burning material below its kindling point. In the second method of smothering, oxygen is cut off by throwing sand or some other blanketing material on the flames. But in a new method, the principle of catalysis is made use of. Catalysis is the process of greatly increasing the velocity of a chemical reaction by the mere presence of a substance, the catalyst, which itself is unchanged at the end of the reaction.

This new process was discovered by accident by two chemists who perfected it, but can give no satisfactory explanation of the phenomenon they have unleashed. These men, Charles Allen Thomas and Carroll A. Hochwalt, consulting chemists of the Fyr-Fyter Company of Dayton, Ohio, frankly admitted their mystification when they described their process before a general session of the American Chemical Society at St. Louis, Missouri, recently. While they demonstrated the effectiveness of their method, they threw the "why" into the laps of the assembled scientists. Telling of their discovery, Mr. Thomas said:

"We started work by adding material to water to increase its effectiveness on wood fires. We accidentally found that sodium potassium carbonate would even put out a gasoline fire. This led to further work which, in turn, brought us to the remarkable discovery of the 'catalytic method' of extinguishing fire.

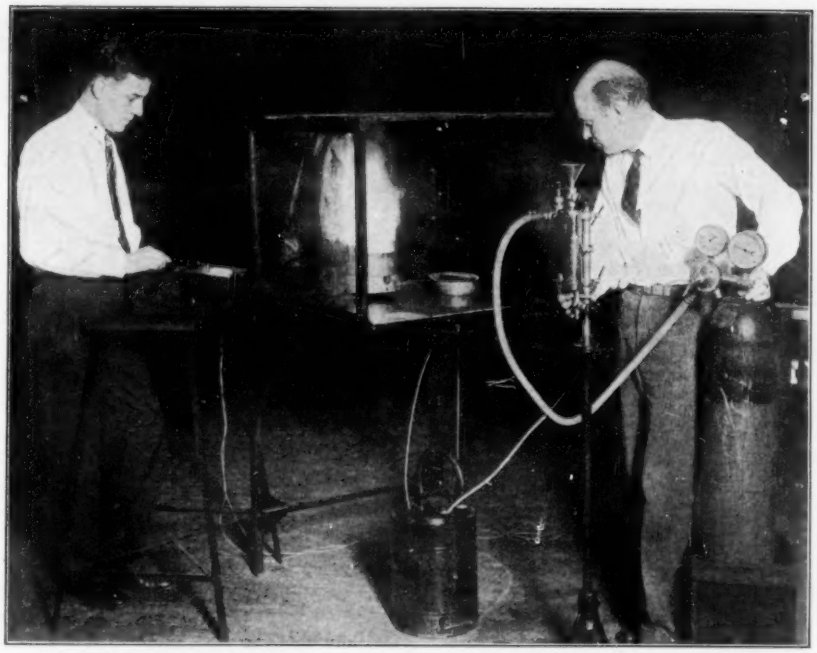
"Water is a representative medium for cooling material below its kindling point, and carbon tetrachloride, foam, and various other means have been used to blanket oxygen from the fire. Yet this catalytic method neither cools nor blankets a burning oil fire.

"We discovered that a solution of sodium potassium carbonate extinguished an oil fire. We thought we knew why this compound put out the fire, namely, because the compound had given off carbon dioxide which blanketed the flame. Thus we thought that ammonium carbonate would work even better, since it decomposes much easier to carbon dioxide. We were greatly surprised when it did not work. Further work showed that this phenomenon resided with the potassium. Rubidium of caesium also exhibited this remarkable result.

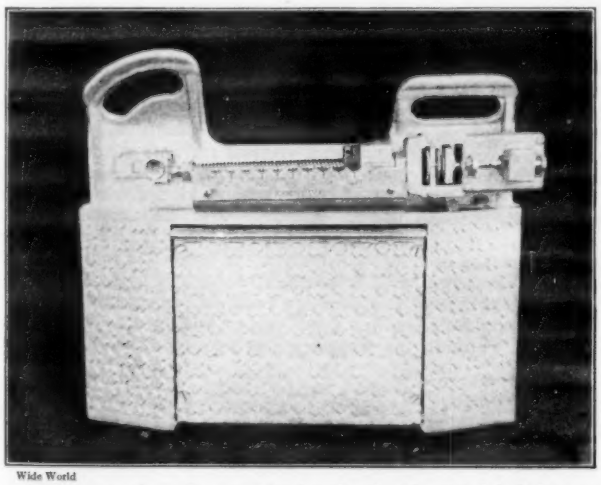
"After developing an apparatus for testing, it became possible to investigate the water soluble compounds for the presence of the same catalytic flame-extinguishing property as is possessed by sodium potassium carbonate. With a few minor exceptions, every element capable of forming a water soluble salt was studied. Practically all of the salts of the alkali metals exhibited this catalytic fire-extinguishing effect.

"A peculiarly interesting point is the fact that all of the compounds of the alkali metals that have oxygen in them have a

(*Please turn to page* 85)



Demonstrating with laboratory equipment the new "catalytic method" of quenching flames, an artificial fire being used for the experiment



Wide World

Close-up view of a new single-wheel scale which is being used in Chicago in checking overloading of trucks to enforce a city ordinance. For either front or rear wheels

Two of these scales are placed in position, the truck is backed on them, and the weight of each wheel noted. Besides being very efficient, these scales are portable

Learning to Use Our Wings

This Department Will Keep Our Readers Informed of the Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN
In charge, Daniel Guggenheim School of Aeronautics, New York City

The Keystone "Pirate"

THE Keystone *Pirate*, shown in our photograph, is one of the best bombardment planes of the day. It weighs 7115 pounds empty, carries a bomb load of 2150 pounds, and with a crew of five and sufficient fuel for 500 miles, has a gross weight of 12,230 pounds. It is equipped with two geared Liberty engines, and is sturdy and clean in design, with the engine nacelles faired nicely into the lower wing.

I. and A.

The Keystone *Pirate*, described in these columns and illustrated above, will carry 2150 pounds of bombs, a crew of five, and fuel for a flight of 500 miles

The Army bomber is not always the best example of refinement in aerodynamics, however. It is in the disposition of armament, crew and bombs that the main interest of the *Pirate* lies.

In the fuselage between the wings is a large bomb bay. A standard army bomb rack is installed. Any combination of bombs can be carried to make up the full load, from a number of small 100- or 200-pound bombs to one weighing a ton. The bombs are dropped by a release mechanism operated from the bombardier's position in the nose of the plane. In front of the bomb bay is the cockpit for the two pilots who sit side by side, while in the nose is the station for the forward gunner who is placed above the pilots, either one of whom can act as bombardier. Behind the bomb bay, in the fuselage, is a compartment for a radio operator and another gunner. A catwalk over the top of the fuselage provides a passage-way from front to rear cockpits permitting personal contact between all members of the crew.

The armament is such that there are practically no blind areas. Two Lewis machine guns on a flexible mount are in the nose of the fuselage at the top, while above the rear cockpit are two more in addition to a single machine gun that can be fired through an opening in the floor.

By a process of evolution the American bomber has attained a flexibility and completeness as a fighting machine which is remarkable.

Airship Hangars

DR. ARNSTEIN, in "Aeronautics," published by the American Society of Mechanical Engineers, discusses the important subject of airship hangars, which owing to their enormous size constitute quite a problem for the architect and structural engineer. Wind pressures are a particularly difficult proposition in the design of such structures.

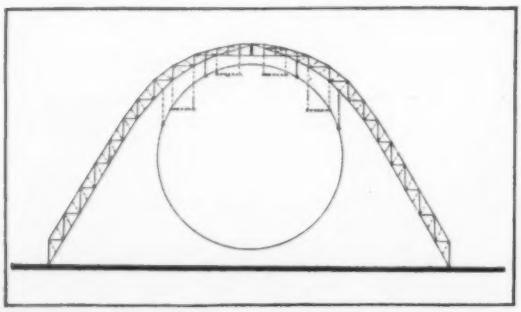
We are always accustomed to thinking of wind as producing impact pressure on the side of buildings. This view is quite erroneous. Impact pressure prevails only over a very small portion of the windward face of a building. The air sweeping over the building at a greater speed than in unobstructed areas actually produces suction over the greater part of the surface. This is shown clearly by the diagram below.

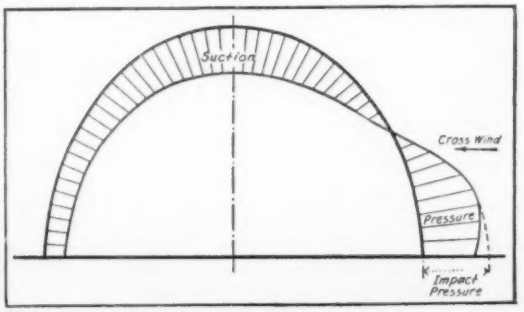
A hangar will not always fail by caving in. It may burst outwards, an idea entirely at variance with our usual conceptions. It can readily be seen that to meet the real existing wind forces, the structural engineer will have to make quite different computations than those he usually assumes to be correct.

Dr. Arnstein recommends a circular hangar, in which air disturbances and therefore forces are less than in hangars of more conventional block type.

Another reason for the circular hangar is that with lesser disturbance of the air flow, the handling of the airship when taken in or out of the hangar is much easier. The semi-circular design avoids most of the eddies and vertical currents which accompany the wind flow over and around a large rugged shed with wide-spanning square doors. Further, such an arched design provides the maximum strength and consequent economy of labor and materials.

The arched cross-section lends itself also to neat suspension and erection of the airship at the center with plenty of workshop space on the floor on either side.





Left: Cross section of arched circular airship hangar, showing suspension of ship and the adjustable platforms

Right: Note the small area of wind pressure, as compared with the enormous area affected by the resulting suction

It is not impossible that even for large airplane hangars, a similar principle might be found useful.

Welding Strong Aluminum Alloys

THE strong aluminum alloys such as duralumin are remarkably well adapted to aircraft construction, owing to their strength and lightness. The main drawback to their use is the multiplicity of rivets. Riveting requires three or four operations—piercing, countersinking, inserting the rivet, and driving. The reason steel fuselages instead of dural fuselages have been used hitherto is because steel fuselages can be so readily welded together.

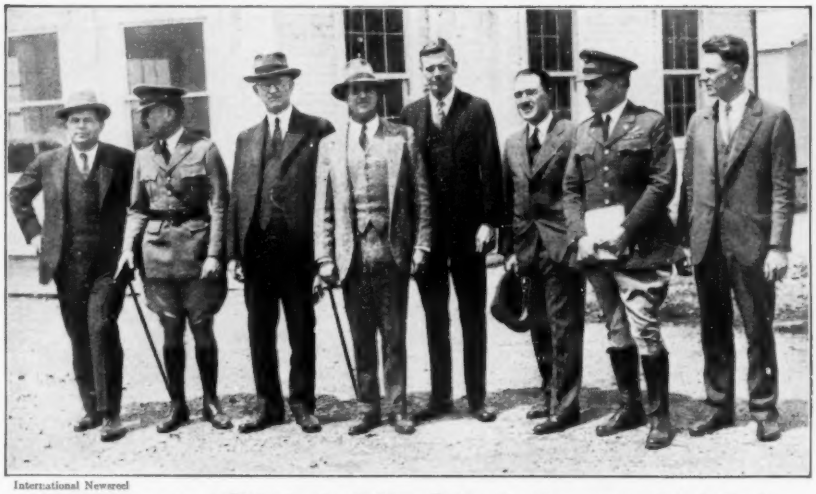
Now the Aluminum Company of America after lengthy investigation announces that the strong aluminum alloys can be successfully spot welded. Water-cooled electrodes are employed. They are tipped with chromium whose melting point is much higher that that of aluminum. The welding tips are carefully rounded.

The two strips of material are pressed together with a force of nearly 100 pounds, and a current of several thousand amperes is passed between two electrodes and the strips to be joined. With four welding spots, two strips showed a greater strength in the welds than in the strips themselves. The discovery adds a most valuable method to aircraft construction.

A Powerful Passenger Plane

ONE of the important objectives of the Daniel Guggenheim Fund for the Promotion of Aeronautics has been the fostering of passenger air transport in the United States—the only branch of air work in which we lag behind Europe. In pursuit of this policy, the Fund made an equipment loan to the Western Air Express for the purchase of large three-engined passenger planes. These were developed in record time by the Atlantic Aircraft Corporation, and the Fokker *F-10*, the most powerful passenger plane ever built in the United States is a credit to the Fund, the Western Air Express and the builders alike.

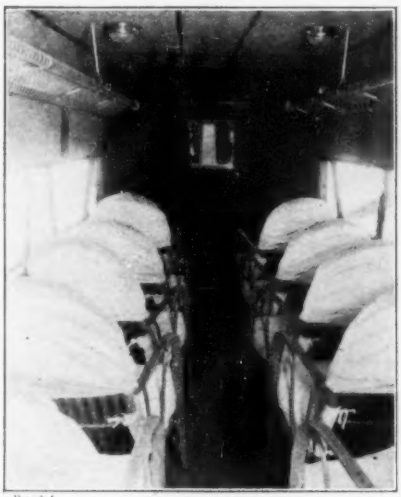
The *F-10* is a monoplane of typical Fokker construction, equipped with three Wasp engines of 400 horsepower each, and carrying a useful load of 4950 pounds which includes 12 passengers, two pilots, and 480 pounds of mail or express in addition to some 300 gallons of fuel and oil, giving a range of 600 miles. With the fully loaded gross weight of 11,500 pounds the high speed is 148 miles per hour.



International Newsreel

Just before a test flight in the Fokker *F-10*. On the extreme left is Prof. Alexander Klemin, aviation editor of the SCIENTIFIC AMERICAN. Fifth from the left is Colonel Charles A. Lindbergh who piloted the ship on the flight

The plane is structurally sound and well streamlined. Lindbergh, with whom the writer of these notes had the privilege of a trial trip in the *F-10*, pronounced it an excellent flying ship. The large useful load and its very high speed will be powerful factors in making its operation profitable. But the most interesting points in the machine are to be found in the interior accommodations.



F and A

A view of the interior of the *F-10*, showing the comfortable seats

The passenger cabin is free from all obstructions and bracing. It is rectangular in shape, 18 feet three inches long, six feet one inch high and five feet wide. The seats of wicker construction are light, yet very comfortably upholstered. Fastened to the floor by only two legs, they permit of considerable movement at the will of the passenger. Above each row of seats there is a shelf for clothing or baggage. Neat nickel-plated fittings, ash trays, large sliding windows, which slide longitudinally, all serve to give the maximum comfort to the passenger. For use in cold weather, an exhaust heater is connected to the cabin from the center engine.

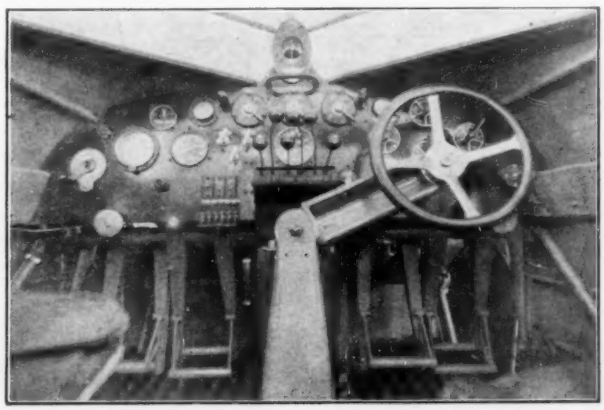
Noise is one of the difficulties of aviation. It is impossible to conceive of a design where engine and propeller will be entirely noiseless. The more promising plan for the present is to try to deaden the noise. In the *F-10* the walls, ceiling, and floor of the cabin are padded with balsa wool. As a result, even when the engines are developing their full 1200 horsepower, it is possible to converse with fair ease.

The pilot's compartment is unusually roomy and comfortable. Between the

(Please turn to page 80)

F and A

A three-quarter front view of the Fokker *F-10*, the most powerful passenger plane built in the United States



Pilots' cockpit in the *F-10*. The dual-control column is hinged in the middle so that either pilot may use it

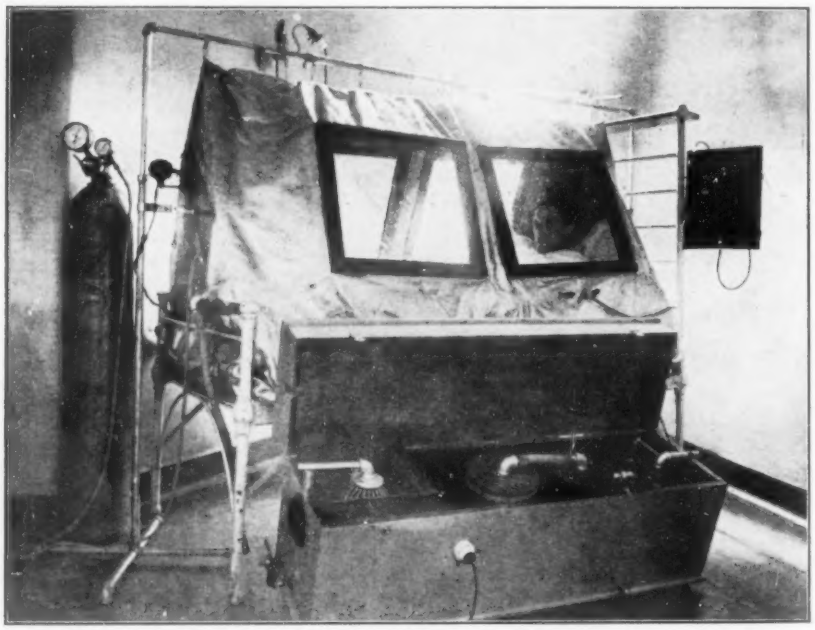
Industries From Atoms

A Department Devoted to the Advancements Made in Industrial and Experimental Chemistry

Removing Bootblack Stains

SPOTS on light-colored hosiery put on by the bootblack are usually nigrosine, the favorite dye used in black shoe polishes. These may be removed by the application of benzaldehyde if properly used, according to M. H. Goldman, research associate of the National Association of Dyers and Cleaners. Mr. Goldman recommends the following procedure:

"Spot the stain with benzaldehyde, following this treatment with 5 percent ammonia, meanwhile gently rubbing the spot. A single treatment is sometimes all that is required, but a second and in some cases a third application of the benzaldehyde followed by ammonia may be necessary before the spot is completely removed. The spot to which the treatment is applied is finally sponged with dilute alcohol to remove any excess of benzaldehyde that may be present, and also to avoid leaving a ring on the fabric."



The oxygen tent which has been developed to meet requirements for administering oxygen to sufferers from pneumonia. The box in the foreground contains canisters of soda-lime and ice for cooling the oxygen

Oxygen Used to Fight Pneumonia

ALTHOUGH attempts were made to employ oxygen as a therapeutic agent 200 years ago, the history of its medical success is comparatively short. Because the first attempts failed, physicians came to look askance upon it. As a result, from the time its practical service was demonstrated on gassed soldiers in 1917, it has fought an uphill battle against prejudice. Tradition established against it is still strong.

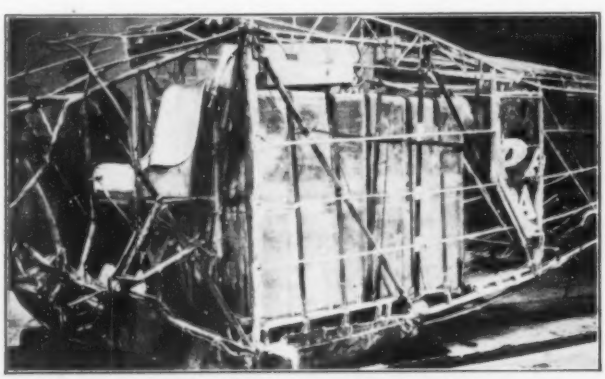
The first methods were to give oxygen to a patient through a mask over his face or through a catheter which was inserted into his nostrils. Both of these devices caused discomfort, and finally the oxygen tent was invented. This tent fits over the patient's body as shown in the illustration, being tied about his waist to make it air-tight. The tank at the right in the movable apparatus contains ice which cools the oxygen in order that the temperature in the tent may be comfortable. In the other cylinder at the left is soda-lime, which absorbs the carbon dioxide produced.

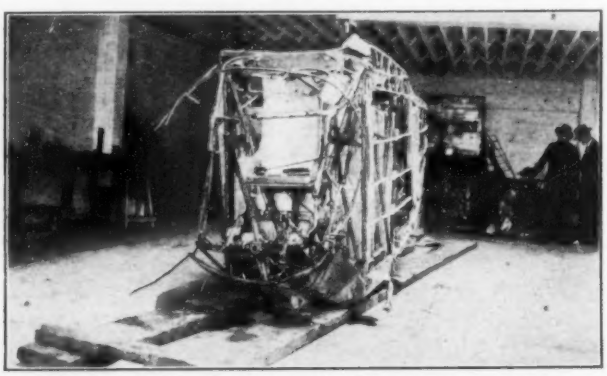
In operation, the oxygen passes over the ice and into the tent. Thence the air passes out, through the soda-lime where the carbon dioxide is absorbed, over the ice and back into the tent. The apparatus seen between these two tanks is for testing the percentage of oxygen in the tent. This apparatus can be in operation five minutes after a call has been made for it.

Instead of being of the normal 20 percent in the air we breathe, the oxygen in the chamber is raised to a percentage between 30 and 70 percent. This higher percentage of oxygen helps carry the patient through the crisis of his sickness, to support life until he shall be able to complete a natural recovery. Of 16 cases reported by Dr. A. L. Barach, of the Presbyterian Hospital in New York, 11 recovered, and, because the tent or the oxygen chamber is used only as a last resort, the cases treated were very serious.

"The inside of the chamber," Dr. Barach says in describing it, "is lined in certain places by aluminum pipes which contain circulating cold water. A large soda-lime container is placed under the bed. No other apparatus is required.

"The air in contact with the cold aluminum pipe is chilled, the moisture is condensed on the surface of the pipes and the cool dry air passes to the floor of the chamber where the carbon dioxide is removed by

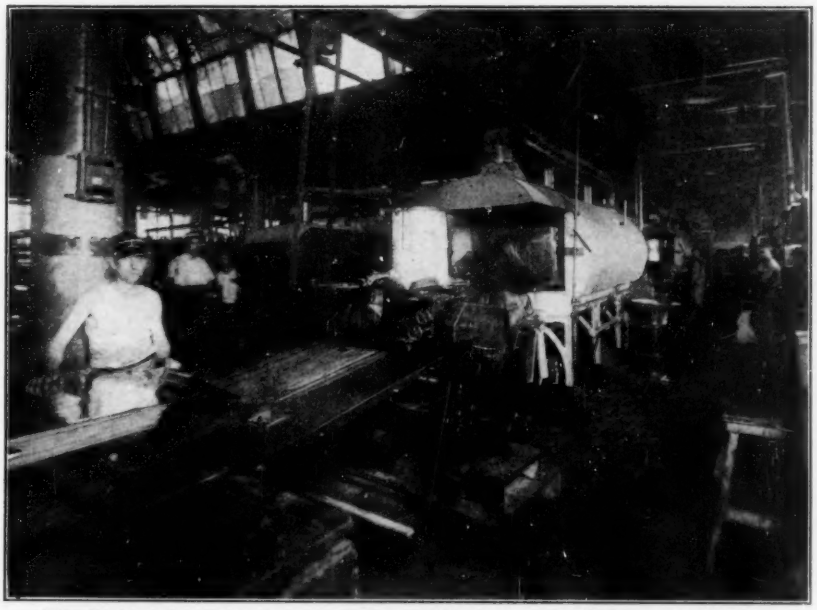




The chemists' contribution to safety in aviation proves its merit. Although this plane crashed to the ground in a nose-dive, the newly developed alloys used in its construction, and the welded joints, were equal to the occasion. The pilot escaped without serious injury, although he was seated between the gas tanks and the motor. Thus, by refinements in construction, is the future safety of aviation made more positive

contact with soda-lime. The air is warmed by the heat of the patient's body and passes to the roof with additional moisture and carbon dioxide. It is then chilled again and the process is repeated. By the use of these convection currents there is obtained an adequate removal of carbon dioxide, moisture, and heat."

Dr. Barach feels that there is no question about the service performed by oxygen in helping pneumonia cases. With a large part of a patient's lungs closed, the heart must work extra hard to pump blood to the unaffected parts. Enriching the oxygen content in the air speeds up the chemical reactions in the patient's lungs, thus easing the strain on the heart (which is really the dangerous phase of a pneumonia case). While he does not say that oxygen is a curative, he believes that it is obvious that it is a supportive; that is, that it prolongs the life of a patient until he shall have passed the crisis and be able to accomplish a normal recovery.



The longest lacquering oven in the world is illustrated above. This particular unit is employed for drying the lacquer on the metal that is used for making caps for jars. Strips of the metal are being fed into the furnace

New Synthetic Solvents Make Possible Odorless Lacquer

WHEN Mother decided that the living room simply "must be done over this spring," Dad resigned himself to at least a week of turmoil around the house and a "painty" smell for another week or two which would make the room uninhabitable and give Mother a headache. Neighbors dropping in would exclaim, "My, doesn't it look nice," with the mental qualification, "but it certainly smells terrible."

This familiar experience is recalled to emphasize one of the many ways in which modern chemistry has contributed to the comfort and convenience of all of us, even though our unfamiliarity with the science is such that we would not recognize a molecule if one jumped up in our lap. Thanks to the chemists who have recently developed entirely new kinds of lacquers, it is now entirely possible for the painters to begin work in the morning, refinish the room, and leave it before Dad gets home from the office, thoroughly dry and without any unpleasant lingering odor.

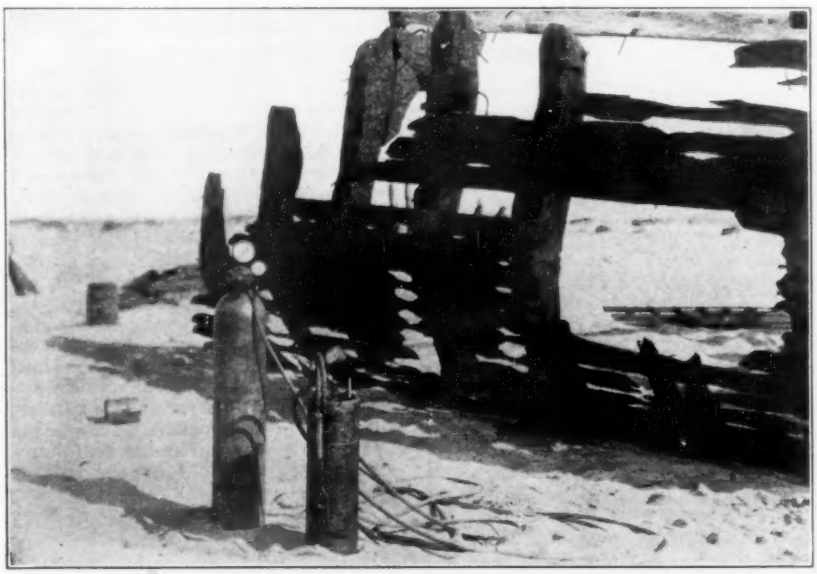
Nitrocellulose lacquers, so generally adopted in the past few years as automobile finishes, include the property of quick drying among their other admirable qualities. But the development of odorless solvents for such lacquers is an even more recent improvement and constitutes a triumph for synthetic chemical research. The story of these new lacquer solvents is told by E. W. Reid and H. E. Hoffmann, of the Mellon Institute of Industrial Research in Pittsburgh, in *Industrial and Engineering Chemistry*.

"Synthetic chemistry has seen in the last few years the development of an entirely new line of aliphatic chemical compounds. Among the most important of the products are ethylene glycol and its derivatives. The ethers of glycol, notably the monoethyl ether, have found wide use in the lacquer industry on account of their high solvent action. The monoethyl ether of ethylene glycol is being marketed under the name Cellosolve. Because of its high solvent action on nitrocellulose, high-dilution ratio with hydrocarbons, and present low price, it has made possible the formulation of good lacquers at a low cost.

"In addition to Cellosolve itself, the other derivatives offered to the lacquer industry at this time are Cellosolve Acetate (the acetate of the monoethyl ether of ethylene glycol), and Butyl Cellosolve (the monobutyl ether of ethylene glycol). All three compounds are good solvents for nitrocellulose and resins and are in the high-boiling class—that is, they have slow rates of evaporation. This latter property is a distinct advantage, as the last portion of the solvent mixture to evaporate will be a good solvent for the non-volatile ingredients, and thus give a clear homogeneous film.

"The Cellosolve derivatives have very mild odors, and Cellosolve itself is practically odorless. This is an important consideration in the manufacture of brushing lacquers or lacquers for the commercial finishing of refrigerators, kitchen cabinets, and the like, where a disagreeable residual odor is decidedly a disadvantage. The odors of all three solvents are much more agreeable than that of ordinary denatured alcohol.

"Next to its pleasant odor, the principal feature of Cellosolve is its extraordinarily high tolerance of coal-tar hydrocarbons. This property is no doubt attributable to its dual ether-alcohol nature, and it is indeed an advantage in the preparation of industrial lacquers containing large amounts of the cheaper diluent, toluene. Butyl acetate will tolerate 2.5 times its own volume of toluene before it ceases to be a solvent for nitrocellulose, but Cellosolve will take about 5.2 times its volume of toluene.



A seeming contrast between the old and the new—the wave-torn hulk in the background, and the modern gas tanks in front—this photograph serves to illustrate how an effect was obtained, with the aid of modern chemistry, for the "movies." The scenario called for an ancient weather-beaten hull. The ravages of time and weather were successfully imitated in a comparatively short length of time by employing the all-consuming flame of the oxy-acetylene torch for reducing timbers to the "aged" state shown above

Properties of Stainless Steels

WITH stainless steel finding new uses every day and appearing in hundreds of articles of everyday use, the properties of this useful metal are of general interest. While there are many kinds and grades of stainless steel, they are all characterized by their high content of chromium. F. R. Palmer, writing in *Chemical and Metallurgical Engineering*, classifies stainless steels according to their chromium content, dividing them into three groups, *A* with less than 14 percent; *B* with more than 16 percent and *C*, with enough chromium and nickel to make the steel non-magnetic. The properties of the three groups are tabulated below.

The A-B-C of Stainless Steels

	A	*B*	*C*
Analysis	Chromium less than about 14 percent. Carbon less than about 0.4 percent. May contain small percentages of tungsten, copper, nickel, silicon, molybdenum, et cetera. This group is magnetic.	Chromium more than about 16 percent. Carbon less than about 0.4 percent. May contain small percentages of copper, nickel, silicon, molybdenum, tungsten, et cetera. This group is magnetic.	Contain enough chromium and nickel to make steel austenitic and non-magnetic. Usually contain twice as much chromium as nickel or vice versa.
Heat Treatment	Respond to hardening, tempering, and drawing. Resulting physical properties depend on analysis.	Heat treatment not recommended. Naturally soft—usually having a Brinell hardness under 200 and seldom over 250.	Do not respond to heat treatment.
Toughness	Structurally dependable. Not brittle in sharp-notched sections or under impact.	Have low impact resistance especially in notched sections. Not dependable for bolts and similar notched parts when used under impact.	Extremely tough at all times. Thoroughly dependable for any type of shock service within the capacity of their strength.
Grain Growth	Not subject to excessive grain growth at incandescent temperatures. Thoroughly dependable at any temperature for supporting any load or shock within carrying capacity.	This group is divided with regard to grain growth. Simple chromium irons and those containing high silicon or aluminum subject to excessive and dangerous grain growth and become very brittle. Grain growth reduced by use of carbon manganese, copper and nickel. Some steels containing these elements not subject to grain growth at all.	Do not become brittle due to grain growth—thoroughly dependable for high temperature service.
Hot Working Qualities	Readily forged, pierced or rolled. Air harden on cooling.	May be forged, rolled or pierced. Steels subject to grain growth must be heated very quickly. Those not subject to grain growth are heated in the usual way.	May be forged, rolled or pierced. Become work-hardened progressively below 1800 degrees, Fahrenheit. Do not air-harden.
Cold Working Qualities	Can be cold drawn into wire, cold rolled, bent, formed, upset, coined and deep drawn.	Can be cold drawn into wire, cold rolled, bent, formed, upset, coined and deep drawn. Not quite as easily worked as Group A with equal carbon content.	Can be cold drawn into wire, cold rolled, bent, formed, upset, coined and deep drawn. Work-harden twice as rapidly as Group (A).
Machining	Machine readily with properly designed tools.	Machine readily with properly designed tools.	Very difficult to machine. An outstanding objection to this group.
Riveting	Make excellent cold rivets. Not recommended for hot rivets driven above 1500 degrees, Fahrenheit, on account of air-hardening.	Due to low impact values, not desirable for either hot or cold rivets.	Excellent for either hot or cold rivets. Hot rivets may be driven at a high temperature.
Welding	Can be welded autogenously and by electric arc or resistance. Weld air-hardens. No grain growth.	Can be welded autogenously and by electric arc or resistance. Those metals subject to grain growth become very brittle adjacent to the weld. Those metals not subject to grain growth yield satisfactory welds.	Can be welded autogenously and by electric arc or resistance. Weld does not air-harden and is very tough. An excellent group for welded products.
Corrosion Resistance	Very satisfactory for resisting weather, water and many organic and inorganic corrodents.	Possesses corrosion resisting properties superior to group (A).	Corrosion resistance depends largely upon chromium content. This group will resist some types of action that groups (A) and (B) will not. With chromium over 16 percent the resistance is excellent.
Scale Resistance	Useful for temperatures up to about 1500 degrees, Fahrenheit.	Superior to group (A)—recommended for temperatures about 1500 degrees, Fahrenheit.	The high chromium steels are as good or better than steels of equal chromium in group (B).
Strength at Elevated Temperatures	Much better than straight carbon steel for temperatures up to 1000 degrees or 1200 degrees, Fahrenheit.	Steels not subject to grain growth are better than group (A) above 800 degrees Fahrenheit. Steels subject to grain growth not safe at high temperatures.	Better than group (B) at temperatures over 1000 degrees, Fahrenheit.

Opportunities in Chemistry

DANGER to industrial progress is seen in the shortage of qualified men for research by Dr. Charles H. Herty, past president of the American Chemical Society and adviser to the Chemical Foundation, in addressing the Institute of Chemistry of the American Chemical Society. "Industrial research which is the mainspring of progress is threatened with curtailment as demand for qualified men outstrips the ability of our universities to furnish them," said Dr. Herty, "and in this lies a real danger to industrial progress."

"Sixteen years ago the American business man knew little or nothing about industrial research, but today the need for it has been impressed upon men all over the country in all lines of business and there is a question of curtailing industrial research to fit the men available. There is a very real danger in this unless it is met by pushing forward the education of young men qualified to undertake such work. Education must broaden the understanding and deepen the grasp of young men to fit them to carry on. More must be done in the universities and graduate departments must actively encourage men of high mentality to go farther. No brakes must be placed upon research but rather every encouragement must be offered to young men to fit themselves to carry on."

"Endowed opportunity" to benefit humanity awaits properly trained young men in America's great institutions, according to Dr. E. R. Weidlein, director of the Mellon Institute of Industrial Research, following the same general theme.

"The philosophy of scientific research is that no one can succeed in laboratory experimenting without benefiting his fellow men," Dr. Weidlein continued. "If a scientist is productive in his investigations, his work must result for the good of humanity. If a research laboratory is founded, it is because there is a need for it and it will bring public benefit. Every kind of scientific establishment is administered to meet a public want.

"The character of virtue is best seen in the life of the scientist devoted to the service of research. Our many research institutions and industrial research laboratories have provided endowed opportunity for young men. They have aroused individual ambitions to the highest effort. It follows then that these research establishments must have the proper type of trained research men in the organization.

"The demands for highly trained, experienced research chemists today are greater than they were at any other period of our history. When we speak of experienced research men we mean men who are capable of accepting responsibility, who have the personality to meet industrialists on an equal basis and who are capable of producing results and introducing them to commerce without any great loss of time.

"Personality is the most important quality for a research man who expects to advance in industry. Personality is said to consist of an individual's collective attributes or qualities. It is the sum total of his traits—the mainspring of his being and activities. It comprises his consciousness, his character and his will and is apparent in his conduct and behavior."

(*Please turn to Page* 82)

Tests of this *grainless* wood show remarkable results in wide range of industries!

Enthusiastic letters of praise coming in every day. Many report new and unique uses. Send for large free sample and find out what Masonite Presdwood will do for you.

FOR STORE FIXTURES

Two years we waited to tell the story of Masonite Presdwood — and two days after our first announcement inquiries began pouring in from every section of the country. Requests for samples already run up into the thousands. And in the meantime, this *grainless* all-wood board has been subjected to hundreds of tests by leading manufacturers in all sorts of industries.

These tests prove conclusively that Masonite Presdwood won't crack, check, split or splinter; that it possesses remarkable workability and uniform strength; that it is very dense and tough, highly resistive to moisture, and takes any finish beautifully. Presdwood also has a very smooth attractive surface on the face side, and requires no paint for protection.

The Story of Fido

Down in Gulfport, Mississippi, Presdwood was recently used in building a speed boat called "Fido". Thanks to this *grainless* wood, the boat when completed weighed only sixty-two pounds, although it is eight feet long and has a forty-eight inch beam.

Knowing that Fido could do better than thirty-one miles an hour over a straightway course, its owner decided to enter it in the Class B Outboard Race in the Gulf Hills Regatta—and Fido won the race!

Better bread boxes

A certain Wisconsin manufacturer, whose name will be given in request, has made some very severe tests with Masonite Presdwood for bread boxes, and reports that it is far better for this purpose than any other material he has ever tried.

In making the tests a large rotating steel cylinder was used; a cylinder equipped with baffle plates, hazards and heavy spikes. The boxes to be tested are put inside of this machine, each box being hurled from one side to another and from one baffle plate to another so that it does not catch the impact in the same place twice in succession.

A box made of the regular conventional material failed under a total of 871 drops. The box made of Masonite Presdwood did not fail until it had withstood a total of 1942 drops!

FOR PANELING

In a recent letter, Mr. Leo. A. Margola of the Chicago Art Institute writes: "I have been using Presdwood for remounting valuable canvas paintings and for backing and protecting ancient and modern works of art. Before adopting this material, many severe tests proved it to be a safe, durable material, which resists the action of moisture, heat and cold without twisting, wrinkling or warping and with minimum contraction and expansion."

Several railroads are now using Presdwood as paneling in their new Pullman Cars. It is also in wide demand for outdoor and indoor signs, store fixtures, starch trays for candy factories, clothes hampers, radio boxes, cupboards, doll furniture, packing cases.

New uses practically every week

And almost every week we hear of new uses: incubators, barbecue stands, display booths, work-bench tops, bedroom screens, plaques, music cabinets, lining for trunks and wardrobes, theatre props, concrete forms and invalid trays. In addition, Presdwood is now being tested for use by manufacturers of electric equipment, organs, airplanes, clocks, tools, bowling alleys, chemicals, farm wagons, trucks, automobiles, iceless refrigerators and church furniture!

Masonite Presdwood may be exactly the material you are looking for. Write for large, free sample. It will be sent promptly on request without placing you under any obligation.

MASONITE CORPORATION
Sales Offices: Dept. 1678, 111 W. Washington St.
Chicago, Illinois

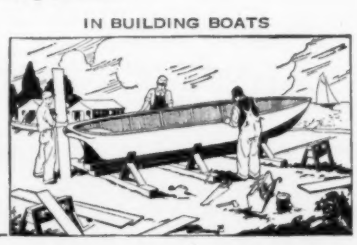
Mills: Laurel, Mississippi

FOR PLAYHOUSES AND TOYS

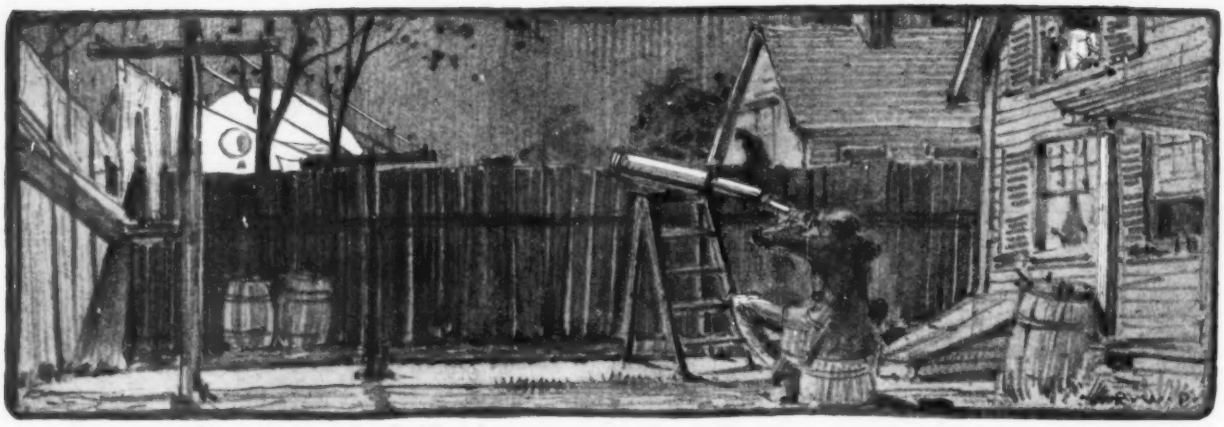
Masonite PRESDWOOD

Made by the makers of
MASONITE STRUCTURAL INSULATION
REG. U.S. PAT. OFF.

IN BUILDING BOATS



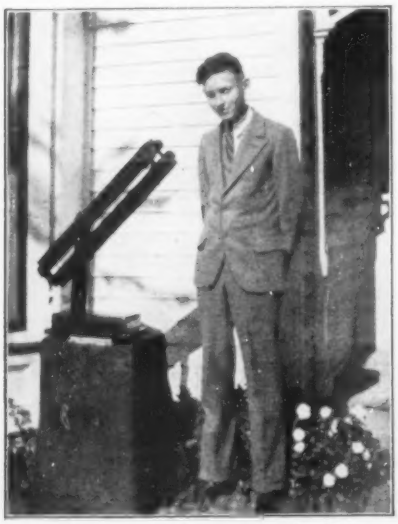
© 1928, M. F. Co.



The Back Yard Astronomer

A Department Devoted to Interests of the Amateur Telescope Maker

WARM weather has come and people who have put off making their telescopes wish they had done the work during the long winter evenings; people who have completed it will have the use of their telescopes during the comfortable summer evenings. Now is the time for new aspirants to begin studying up on the work, from "Amateur Telescope Making."



Mr. Murray and his four-inch reflector

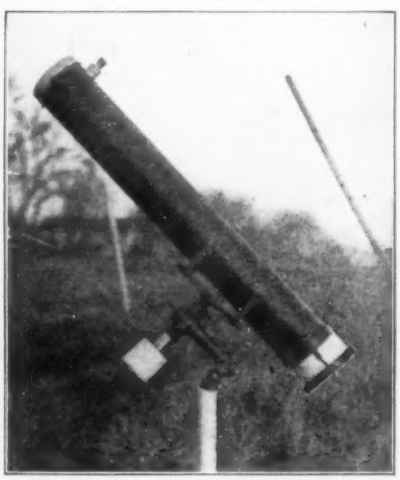
This month we show three more home-made telescopes. Mr. Frank Murray of Axtell, Kansas, made the telescope shown on this page. Mr. Murray says: "Although my telescope is small, it is wonderful what it will reveal in the heavens. The mountains and craters of the Moon, four of Jupiter's satellites, the rings of Saturn, and the phases of Venus are all clearly visible through it.

"After three months of work I succeeded in producing a parabolic mirror, but it was certainly not without its difficulties. The total cost of the telescope was less than 25 dollars and I wasted a great deal of material due to inexperience.

"The mirror is four inches in diameter, one half inch thick, and has a focal length of 30 inches. The tube is constructed of six cypress slats screwed to a hexagonal block of wood at the bottom and bolted to an iron ring at the top. I have a portable altazimuth mounting with a drawer in the base for accessories, and a fixed equatorial mounting of the German type for astronomical work.

"I ground and polished a lens of three eighths inch focal length for the eyepiece, giving a magnification of 80 diameters. I also made the diagonal. Thus the telescope is completely home-made excepting the finder, which was a pocket spy-glass."

Here is another letter from the middle-west, sent in with a photograph, by Mr.



Mr. Bergstrom's six-inch reflector

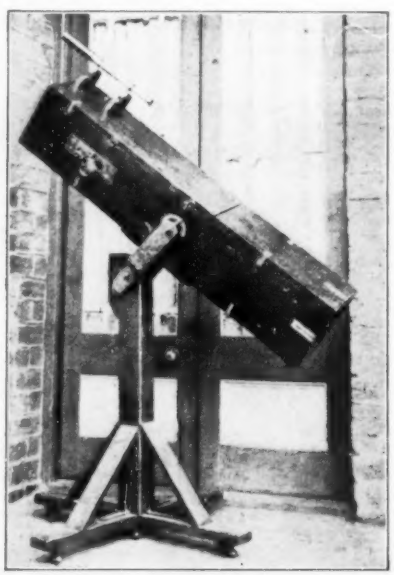
H. O. Bergstrom, a locomotive engineer at North Platte, Nebraska (P. O. Box 491). Mr. Bergstrom's first telescope was described in the issue of December, 1927, page 554. He now writes as follows, concerning a second he has finished: "I just got your letter a little while ago. I am at this moment at the round house getting ready to go out on a 'Green Fruit' (about 100 of 'em), so thought I would mail you two snapshots I have in my pocket. They are of the eight and one half inch reflector I had mentioned to you before.

"The mounting is built on the same general plan outlined in your book. The axes are made up of two one and one half inch cross tees joined together by a nipple, set at right angles to each other, and milled out to allow a one and one half inch pipe to slip through for polar and declination motion. Plugs with holes drilled through, threaded and fitted for wheel-handled set screws, hold the axis in position after the tube has been set.

"For those who have only a little spare time to use playing with telescopes, this mounting is quickly and easily made and is very satisfactory. Worm gears and setting circles can easily be attached."

We reproduce also an interesting photograph of a telescope, sent in by Mr. P. J. Naudé, 241 Market Street, Fairview, Johannesburg, South Africa. Mr. Naudé's telescope has a seven-inch mirror. He expects soon to make a 14-inch. He furnished no further details of his instrument, but the photograph speaks for itself. The SCIEN-

(*Please turn to page* 84)



A telescope made in South Africa

DON'T FOOL YOURSELF

Better to be safe than sorry when halitosis is involved

Halitosis may get *you discharged*

Employers prefer fastidious people . . . halitoxics not wanted.

MORE and more, employers insist on having about them people who are fastidious. Sooner or later, those with halitosis are "let out."

The true reason for discharge, however, is usually hidden under such phrases as "Inefficient," "You can do better elsewhere," "We need a more experienced person," etc.

Realize these facts about halitosis. That, due to modern habits, it is much more prevalent than is suspected. That it is a definite liability in friendships, affections and business. That you can have it and not know it.

The one means of being sure that you are free from it is to rinse the mouth systematically with Listerine. Every morning. Every night. And between times when necessary, especially before meeting others. Keep a bottle handy in home and office for this purpose.

Listerine ends halitosis instantly. Being antiseptic, it strikes at its commonest cause—fermentation in the oral cavity. Then, being a powerful deodorant, it destroys the odors themselves.

If you have any doubt of Listerine's powerful deodorant properties, make this test: Rub a slice of onion on your hand. Then apply Listerine clear. Immediately, every trace of onion odor is gone.

With these facts before you, make up your mind to keep yourself on the safe, polite and popular side by using Listerine. Lambert Pharmacal Company, St. Louis, Mo., U.S.A.

READ THE FACTS
⅓ had halitosis

68 hair dressers state that about every third woman, many of them from the wealthy classes, is halitoxic. Who should know better than they?

Have you tried the new Listerine Shaving Cream?

Cools your skin while you shave and keeps it cool afterward. An outstanding shaving cream in every respect.

LISTERINE
The safe antiseptic

Strays From the Ether

A Monthly Review of the Progress Made In All Branches of Radio Communication

Perfect Reception in Hawaii

IT is said that the job of radio operator at Pearl Harbor, Hawaii, is the most desired assignment among navy radio men. In this location, radio weather is very nearly perfect throughout the entire year. Static here is almost unknown and operators of the station declare that it is much easier, for example, to maintain uninterrupted communication between Honolulu and Samoa, a distance of 2280 miles, than between Washington and San Juan, only 1150 miles apart, due to the fact that there is heavy static in the Atlantic area which interferes with reception.

And probably the absence of static and the presence of ideal radio conditions are not the only reasons why operators prefer this station. The location is only 15 miles from Honolulu and surf bathing and boating afford constant recreation. When off duty there are radio broadcasts from Honolulu to entertain the tired operators.

Custom-built Sets

IN a recent bulletin issued by the Radio Manufacturers Association, the statement was made that 20 percent of the radio receivers now in operation in the United States have been constructed by custom set builders. In part, the bulletin reads as follows:

"Many of the so-called radio nuts and circuit hounds of a few years back have found in their hobby not merely a fascinating pastime, but a means of embarking in business on their own account, according to a statement recently issued by the Radio Parts Committee. Many of them, as custom set builders, are enjoying incomes of from 10,000 dollars to 15,000 dollars yearly. It is estimated that 20 percent of the receivers now in operation in the United States have been built by these specialists, who frequently operate from their own homes, from small shops or from radio, hardware, or electrical stores. They are, for the most part, highly qualified individuals who serve a discriminating clientele that requires its radios, like its furniture and interior decorations, to be distinctive and individual.

Underwood and Underwood

According to a government report, Chicago is one of the foremost cities representing radio manufacturers in the world. Photograph shows Louis A. Dumond, manager of the Industrial Department of the Chicago Association of Commerce, and H. L. Rockhill, special agent in charge of the district census

"These men do little or no advertising, yet they have developed a large clientele through the reputations which they have acquired from the praise of satisfied users of their receivers. Many of these set builders report that, contrary to what might be supposed, the custom-built receiver is not a serious competitor of the factory-made articles. To a great extent, the former is used in localities where unusual reception conditions require an exceptional receiver —in territories, for example, where extreme congestion on the part of broadcasters requires extreme selectivity."

Tone Control

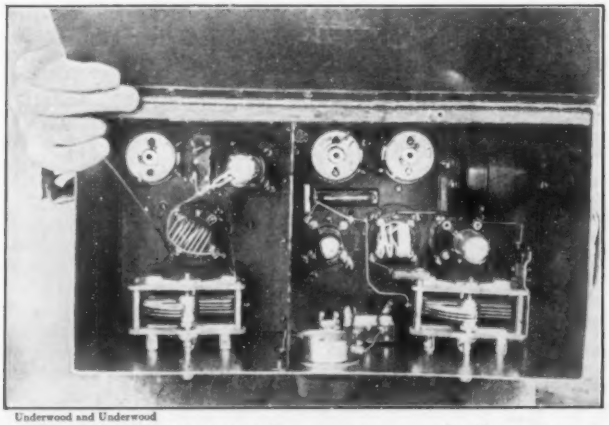
FOR the reproduction of speeches and band music, the operator of a radio receiver usually wants sharp, crisp reproduction. On the other hand, for certain vocal and instrumental pieces, soft, mellow reproduction is most desirable. These two results, however, cannot be obtained without a special control. Therefore, it is suggested that those who wish to get the most realistic reproduction possible from their radio sets employ a simple tone control consisting of a clarostat connected in series with a one quarter microfarad condenser. This combination is to be connected in parallel with the loudspeaker input. Varying the resistance of the clarostat serves to increase or decrease the crispness of the reproduction.

Is a Fixed Condenser Really Fixed?

IN the usual fixed condenser consisting of alternate layers of a dielectric and tin foil, the capacity is often far from fixed. In a poorly constructed condenser, when the condenser is being charged and discharged, the layers of tin foil move toward and away from each other. While it is true that such movements may often be only a millionth of an inch in amplitude, yet when the dielectric is very thin, such a minute movement is enough to cause considerable fluctuation in capacity.

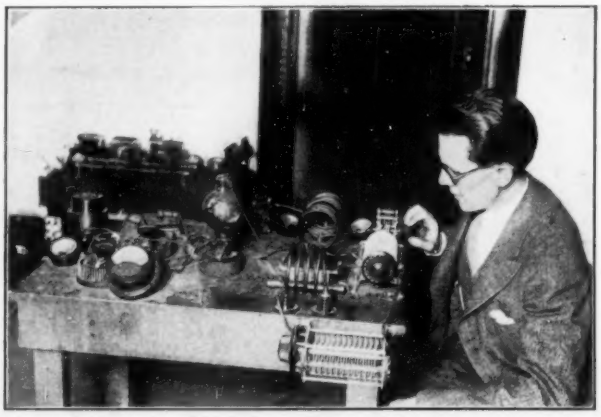
Any motion of the elements of the condenser causes a wasteful power consumption in the condenser itself, especially at radio frequencies. This wasted power may be a large part of the total power in the circuit. To reduce this loss to a minimum, the condenser elements must be held rigidly in place.

The following process of manufacturing a fixed condenser, as developed in the



Underwood and Underwood

The first coast-to-coast two-way communication ever held on the ten-meter band was recently reported from NU-2NJ. A shield grid tube is used in the receiver



This is the ten-meter transmitter at NU-2NJ, located at Upper Montclair, New Jersey. This set has also "worked," for two hours, EF-8CT, Arachon, France

Dubilier Research Laboratories, is now universally accepted as correct. Under a pressure of several thousand pounds per square inch, a dielectric is compressed with the metallic electrodes into a solid mass. Only a homogeneous material such as mica can thus be treated. By this compression, the mica and metal foil are brought into such intimate contact that the tin foil is made to adhere to the mica so that it can be removed only by scraping.

When a condenser is made in this manner, it is obviously impossible for the elements to move and, therefore, there is little chance of power loss.

Patent Situation Clears in Radio

"THE patent situation as regards receiving sets has been definitely stabilized," says Louis G. Pacent, President of the Pacent Radio Corporation. "The manufacturers know where they stand. Consequently they can go ahead producing better radio sets for 1928 with the full knowledge that the product has complete patent coverage and protection."

2XAL to Broadcast Television

IF present plans mature, this fall will find television programs being broadcast over 2XAL, the short-wave radio station of WRNY. The work will be conducted by the Nakken Television Corporation, a subsidiary of the Pilot Electric Manufacturing Company.

According to present plans, production of television receivers will be started at an early date. These will be so constructed that they can be plugged into present radio sets, and if the demand warrants, it is possible that a complete combination broadcast and television receiver will be placed on the market.

Overloading Power Tubes

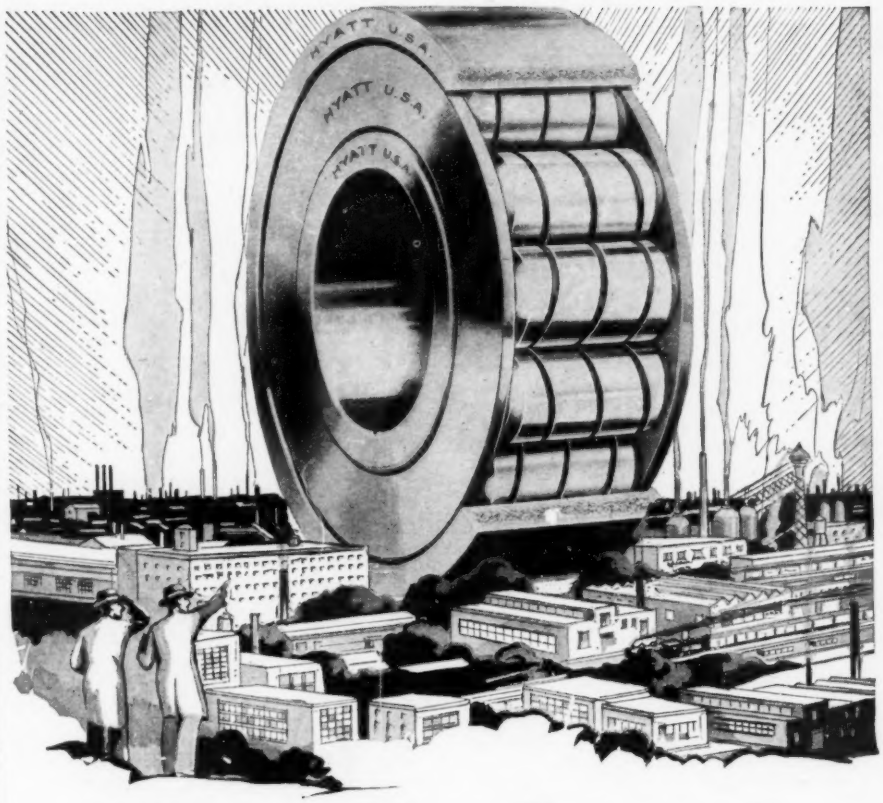
MANY of the present day "B"-battery eliminators supply voltages which are in excess of the maximum to be supplied to power tubes. A 171 type with a 40-volt grid bias should never be supplied with a plate potential of more than 180 volts. If the eliminator supplies a higher voltage than this, distortion will result. If, using the grid bias recommended by the tube manufacturer, distortion is present, a variable resistance such as a standard clarostat should be connected in the "B"-plus maximum lead. By means of this variable resistance, the voltage as supplied to the plate of the tube may be changed until clear reception with a minimum of distortion is obtained. This method of distortion control can be applied to any eliminator.

Radio Safeguards Ferry Boats

A METHOD of avoiding shallows by the use of a radio depth-finding system has recently been installed on ferries plying the Baltic Sea between Germany and Denmark, according to information obtained from the Department of Commerce.

Parrots as Announcers

IF a recent press report that the British Broadcasting Company is teaching parrots to do some announcing is true, many of the radio announcers throughout the world may have to start looking for other positions.



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PRODUCT OF GENERAL MOTORS

The British Broadcasting Company has planned, but as yet the results have not been announced, to stage a parrot program. A dozen birds placed before the microphone will be urged to talk and the first one to utter an intelligible remark will be declared the winner. Just how this intelligible remark will compare with the thousands of remarks made daily by radio announcers we have no means of telling. But we are sure that we would prefer a parrot to some announcers whom we have heard.

Shield Grid Booster Stage

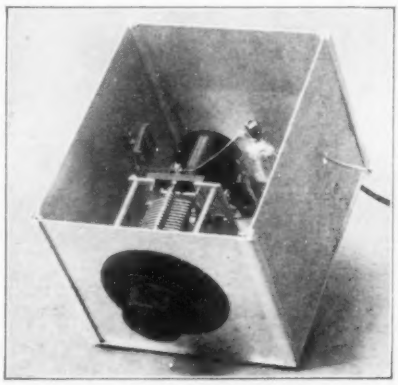
THE introduction of the shield grid 322 tube has opened a new field in radio-frequency amplification, for not only does this tube have an amplification of something like 10 times the ordinary 201-A type, but it also has a very small capacity between control grid and plate so that in some cases neutralization of the radio-frequency amplifier is not necessary.

Of course, every experimenter and set-builder desires to use the 322 tube as a radio-frequency amplifier, because of the tremendous amplification obtainable. However, there are thousands of sets giving good service which are not shielded, and cannot readily be shielded. Consequently, the 322 tube cannot be used, as the circuit and the tube must be carefully shielded to get the utmost from it.

For some time the writer has been experimenting with a one-stage radio-frequency amplifier which could be added to the large number of Browning-Drake sets which are in use. This amplifier employs the shield grid tube. In fact, the design shown in this article exceeded all hopes, for not only does it give a tremendous radio-frequency amplification, but it increases selectivity to a marked degree. It has also been found that the one-stage amplifier can be used, not only on Browning-Drake sets, but on any existing receiver, simply by making a connection to the stator plates of the first tuning condenser. By using this one-stage device, the writer has received signals that were entirely inaudible before.

The construction of the one-stage 322 booster is quite simple indeed as the Browning-Drake Corporation furnishes a kit consisting of the coil, condenser and dial, together with a set of shields, a radio-frequency choke, the four-wire cable, 10-ohm resistances and the mounting hardware, so that all that is necessary for the constructor to purchase is a tube socket, and the following condensers: a one half microfarad, a .0001 microfarad, and a .00025 microfarad.

The picture wiring diagram and the schematic wiring diagram are both given so that little constructional data is necessary. It should be noted, however, that the stator plates of the tuning condenser go to the top of the 322 tube. The two 10-ohm resistances, put in as indicated, cut down the six volts from the storage battery to 3.3 volts which is the correct voltage for the 322. It is noted that the one-stage booster is run from a storage battery as it is not feasible to light the filament of the 322 from raw alternating current.



The assembled shield grid booster stage described in these columns

In using the one-stage booster on any Browning-Drake assembly, all that is necessary to do is to disconnect the antenna from the set, connect it to the antenna post of the booster, which is shown on the case, and to connect the wire lead, which is on the right of the booster, to the antenna post on the Browning-Drake receiver. The ground is left in its position on the set proper.

From the wiring diagrams, it may be noted that a filament switch is inserted in the positive "A" battery lead to control the filament of the CX-322 tube. This makes the separate amplifier unit independent of the receiving set proper and permits it to be used on any radio set. When using the booster on Browning-Drake receivers, particular care should be taken that the set is well neutralized before adding the booster. Volume may be controlled as before on the receiving set.

When using this one-stage booster with other receivers, the wire on the right, which comes from the booster, is connected to the stator plates on the first tuning condenser. The other connections are the same as before. The operation of the booster is very simple indeed as all that is necessary to do is to tune in the receiver by means of the regular control and then tune the booster.

Tuning on the booster is not extremely critical although it increases the selectivity of the set in a marked degree. It also increases, at the same time, the signal strength as much as 50 times. The antenna used on the receiver when this booster is employed should be very short, in fact, not more than 25 to 40 feet, with as much of this vertical as possible.

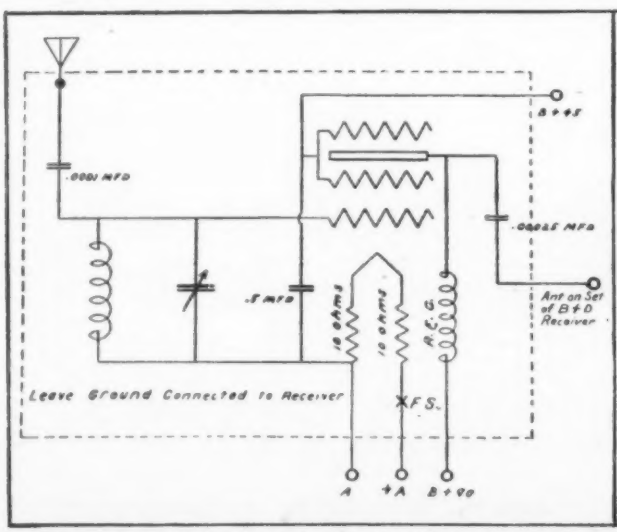
It is sincerely hoped that many, using Browning-Drake receivers, who have wanted to add another stage to their present set, will build the booster, for it gives all the advantages of a set using the 322.

Also others who wish to employ the 322 with all its advantage as a radio-frequency amplifier will want to construct this device, expecially as the 322 tube cannot be used advantageously in an unshielded receiver.—*Written especially for the* SCIENTIFIC AMERICAN *by Glenn H. Browning.*

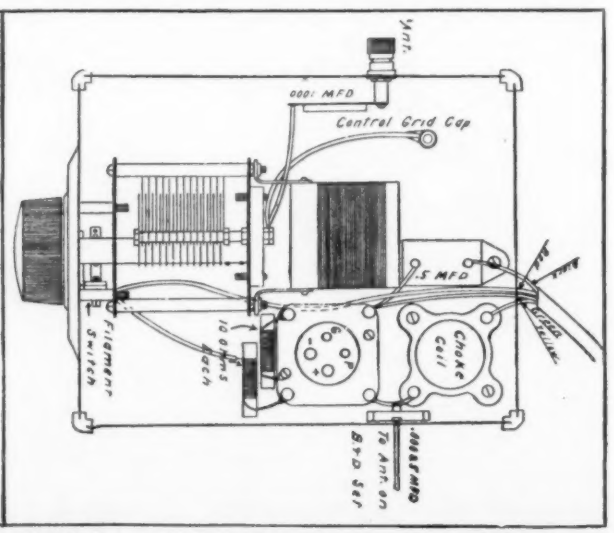
The Future of Television

UNDAUNTED by the various statements made by men high in the radio industry regarding the remote possibility of practical home television receivers, John L. Baird, Scotch television inventor, recently made the confident prediction that before long, owners of radio receivers will be able to sit in their homes and go on a world-wide radio tour, by means of a combination of radio 'phone and television transmission.

It is interesting to note that Mr. Baird has abandoned the use of a moving beam of light scanning the object to be transmitted, and is now using ordinary flood lighting. One significant feature of this is that when the apparatus has been developed to a point



The schematic circuit of the shield grid booster stage. Such a unit may be connected to any existing receiver



This picture diagram shows the same connections as in the schematic at the left, but shows the actual wires

where flood-lighted subjects can be transmitted satisfactorily, ordinary outdoor scenes can be sent without any radical change in apparatus.

Railroads Want Wave Bands

THE Radio Committee of the American Railway Association has recently requested that the Radio Commission reserve a wavelength band for train communication. This method of linking the engine and the caboose of a freight train has been described before in these pages. A section approximately 140 kilocycles wide is desired in the 2250- to 2750-kilocycle band.

Since the range of telephone equipment used on board trains is limited, the interference set up by such transmitters will be very slight and there is probably no reason why such a wavelength band should not be assigned.

"B" Batteries For Short-Wave Reception

THE deficiencies of socket-power devices are highly magnified when used with short-wave receivers and they are, therefore, to be considered impractical for this work. "B" batteries, either of the dry or storage type, are the only really suitable source of plate current for receivers operating below 200 meters.

Grid Leaks

THERE is no reason for the seemingly prevalent assumption that the grid leak in a radio receiver must have a value of exactly two megohms. It will often be found that a lower or higher value will give much better results. Therefore, it is to be strongly recommended that a variable grid leak of standard manufacture be employed. With such a control, this can be adjusted to its greatest sensitivity for distance reception and to a point of greatest stability when only local reception is desired. A high value will usually be found best for distance reception.

Radio in the Hospitals

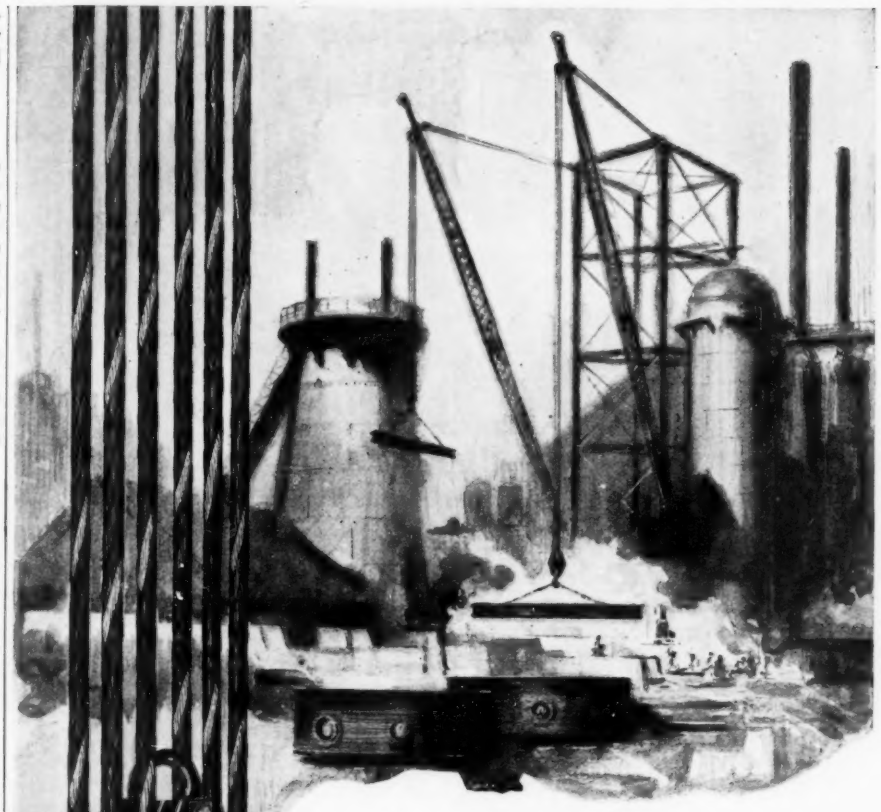
A RECENT survey of the 56 institutions comprising the organization of the United Hospital Fund in New York City shows that 26 of these hospitals already have radio equipment for the entertainment of patients and that others are desirous of obtaining such installations.

Airplane Radio

IF recent tests undertaken by the American Telephone and Telegraph Company between the ground and a Fairchild cabin monoplane develop as rapidly as do most successful radio experiments, it may soon be possible for anyone within reach of a telephone to communicate with anyone who may be traveling by airplane.

"It may be a matter of five years," one engineer stated, "and it may be a matter of a shorter period before we attain our object of an actual connection service between an object moving through the air and the ground."

In the present experiments, apparatus is being used by means of which the wavelength may be changed instantly so that the most efficient and least congested channel may be found.



Motorists

You need a Basline Autowline in your car for emergencies. Made of ¼-inch Yellow Strand wire rope with patented snap hooks for quick attaching. Very strong but small enough to coil flat under a cushion. Ask your accessory dealer.

Handling Heavy Loads

The present quick, efficient methods of handling heavy loads owe much to wire rope; for in nothing else is sufficient strength so nicely combined with flexibility and small diameter.

Manila rope, equal in strength to 1-inch Yellow Strand Wire Rope, would be 3½ inches in diameter.

The Broderick & Bascom Rope Co., manufacturers of Yellow Strand, were pioneers in the industry. All the wire for their famous brand is drawn to their own specifications, from Sheffield Steel.

A strand of yellow distinguishes Yellow Strand in appearance; economy distinguishes it in service.

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An Advertisement of the American Telephone and Telegraph Company

THE widespread ownership of the Bell Telephone System places an obligation on its management to guard the savings of its hundreds of thousands of stockholders.

Its responsibility for so large a part of the country's telephone service imposes an obligation that the service shall always be adequate, dependable and satisfactory to the user.

The only sound policy that will meet these obligations is to continue to furnish the best possible service at the lowest cost consistent with financial safety.

There is then in the Bell System no incentive to earn speculative or large profits. Earnings must be sufficient to assure the best possible service and the financial integrity of the business. Anything in excess of these requirements goes toward extending the service or keeping down the rates.

This is fundamental in the policy of the company.

The Bell System's ideal is the same as that of the public it serves—the most telephone service and the best, at the least cost to the user. It accepts its responsibility for a nation-wide telephone service as a public trust.

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Learning to Use Our Wings

(Continued from page 69)

pilots' seats is a single control-column hinged in the middle so that the upper end may be swung in front of either seat. The wheel control can thus be used by either pilot at will, yet the drawback of a wheel in front of both pilots is avoided. Therefore, the pilot who is not at the wheel has complete freedom of motion. This single-dual system of control is becoming increasingly popular because of its simplicity and practicability.

Shortening Take-off

PLANES used for long non-stop flights, particularly when some pay load is to be carried, must be heavily loaded per square foot of wing area. This entails a long and difficult take-off run. Readers will remember the disastrous attempt of Captain Fonck to take off on a transatlantic flight from Roosevelt Field, Long Island, with a plane loaded some 25 pounds per square foot. Is there perhaps some way of helping the heavily loaded plane at the start? A. Pröll, writing in the *Zeitschrift für Flugtechnik*, has made some ingenious suggestions.

One of them is to use a hydraulic transmission gear and before starting a flight bring a flywheel up to a speed of 10,000 revolutions per minute. The energy of the flywheel is then utilized to help the engine in turning a variable-pitch propeller at a greater pitch than would otherwise be possible. Pröll estimates that transmission gear and flywheel would increase the weight of the airplane only 2 percent, and would decrease the take-off run considerably.

Another plan is to carry a tank of water, in which high pressure is secured by the combustion of gasoline. Subsequent ejection of the water backwards would then serve to increase the initial thrust. Here we can see serious complications and increase in weight.

Still another suggestion is to accumulate vacuum (if such a phrase can be employed) in a large chamber carried on board the plane, and utilize this vacuum to apply suction to the surface of the wing, in order to diminish drag and increase lift at the take-off.

These are internal devices. External devices comprise air-driven towing cars; towing cables; the use of an inclined plane; and finally, the towing of one airplane by another, as has already been done successfully for gliders.

For normal commercial flying, we can see no urgent need for any of these devices. But it is quite possible that intensive use of the airplane will bring such methods into serious consideration a little later.

Ice On the Wings

THE formation of ice on the plane still remains a serious menace to winter flying—in some respects, the most serious menace. Unfortunately the subject is very obscure and does not lend itself readily to laboratory experimentation.

Pilots report ice formation quite frequently in the winter months, and if the formation is at all severe, there is nothing to do but come down.

Clarence Chamberlin and Roger Williams, for example, in one of their attempts

to break the endurance record in a Bellanca plane, met rain, then a drop in temperature to 25 degrees, Fahrenheit, followed by rapid ice formation. The accumulation started at the leading edge, outer edge, and trailing edge of the wing and spread from them until it covered the greater part of the wing. They also noted ice on the cowling, the landing gear, and the leading edge of the tail surfaces. They estimated the thickness of the ice to be three quarters of an inch in some places. Only by dumping over 2000 pounds of gasoline were they able to make a safe landing. They also made the extraordinary discovery that the propeller itself was coated with ice!

Andrus, a noted meteorologist writing in *Aviation*, states that ice formation is to be feared whenever water particles impinge upon the plane's surface in flight through air at temperatures below the freezing point, 32 degrees, Fahrenheit, or 0 degrees, Centigrade. These particles may be big enough to be rain drops falling through sub-freezing air, or they may be tiny particles of fog or cloud at temperatures as low as 21 degrees below zero, Fahrenheit. While they may be existing as water droplets in the free air, upon impinging against the plane they change immediately to ice. When an airplane flies through air containing such particles, its surfaces, in smashing the surface tension of these drops, provide the trigger action to set off immediate crystallization.

It is fairly well agreed that it is not the weight of the ice which brings about disastrous results. It is the spoiling of the upper surface of the wing which, above all, decreases the lifting capacity and increases the resistance. At the same time, the streamline wires cease to be streamline and their resistance increases greatly. Other parts of the plane also have their resistance increased to varying degrees. At the same time, the ice on the propeller diminishes the airscrew's efficiency and may cause unbalance and engine vibration.

The remedies suggested are numerous. The German fliers reported that they found a covering of paraffin helpful when flying through fog and sleet towards the shores of Labrador. Chamberlin on the other hand found that oil which had smeared part of the fuselage did not prevent ice at that point.

The meteorologists suggest that better weather service will enable fliers to dodge those regions where ice forming conditions are reported.

Practical flyers seek to maneuver themselves either right above the clouds, or else to fly very low where the temperature may be higher than at altitude where freezing conditions are encountered.

A dubious suggestion is to have some vibration device shake off the ice as soon as it forms.

The elimination of struts and wires by the use of internally braced wings and landing gears is a helpful idea.

It has frequently been suggested that metal planes could be heated either by chemical or electrical means. The fear is that such a method would require a stupendous amount of energy.

The most popular suggestion advanced thus far is to extend the exhaust stacks of the engine through the leading edges of the wing.

There certainly seems to be a wide opportunity for invention and research on this problem.

Names—and what they mean

Duncan Phyfe Furniture

Back in Colonial times, at the old shop on Partition Street (now Fulton Street), New York City, Duncan Phyfe worked and produced those exquisite pieces of furniture that have only recently become fully appreciated. According to one authority, there are only a few dozen pieces of genuine Duncan Phyfe furniture to be found in all the museums or private collections today. Yet it is said that he developed a style of his own, an American Style, and Sir Purdon Clark asserted that as a worker and designer Phyfe surpassed any of his British contemporaries among whom were the great Chippendale and Hepplewhite. From the first Duncan Phyfe clung to artistic ideals and had a hard fight for business, but about 1800 the Astors took up his furniture and started the Duncan Phyfe vogue. Today the name Duncan Phyfe stands for exquisite design and superb craftsmanship. This reputation is established and secured by the few rare pieces of his handiwork remaining. It is worthy of note that some names begin by being merely tags to identify a product and are soon forgotten. Other names, like Duncan Phyfe, acquire, through years of superlative merit in the product itself, a personality, a definite measure of value that is quickly recognized. Such a name, for instance, is

Tycos

It is accepted as a standard of excellence and value in the invention, manufacture and employment of instruments for indicating, recording and controlling temperature in the home, the office, the factory, the hospital, and on the farm. In industry alone the name *Tycos* symbolizes a Sixth Sense which makes possible the correct and efficient application of the five familiar senses—sight, hearing, smell, taste and touch. *Tycos* on Temperature Instruments means the same as Duncan Phyfe as applied to furniture.

The name *Tycos* was chosen to stand for a great line of temperature instruments. Many years ago, with the ideal of producing instruments of the greatest possible accuracy and reliability in indicating, recording and controlling temperature, the makers sought a name that would always stand for these instruments. *Tycos* is the name. There are *Tycos* instruments for every need. Besides the great industrial line, there are candy, bath and oven thermometers for the home, fever thermometers and sphygmomanometers for physicians. All instruments bearing the name *Tycos* have been built according to the ideal of making instruments that are the utmost in accuracy and dependability.

Tycos Temperature Instruments

INDICATING - RECORDING - CONTROLLING

Office Thermometers
An aid in promoting human efficiency.

Bath Thermometers
To enable you to get the most good from your bath.

Home Sets
Bake Oven Thermometer, Candy Thermometer, Sugar Meter. The secret of accurate results in cooking.

Wall Thermometers
To help you maintain a temperature in your house conducive to good health.

Quality Compasses
To show you the right way in unfamiliar country.

Fever Thermometers
A necessity in every home.

Stormoguides
Forecast the weather twenty-four hours ahead with dependable accuracy.

Hygrometers
To enable you to keep the humidity of the atmosphere in your home correct at all times.

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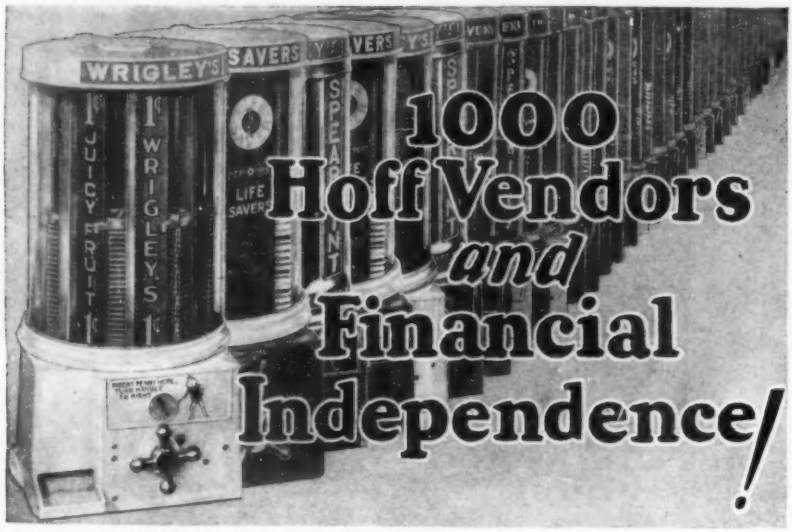

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OWNERS of chains of vending machines are making large profits in every section of the country. We make the famous Hoff Vending Machine, more than 30,000 of which are now in operation, and control the exclusive franchise for distributing in penny vending machines two of the world's largest selling, best advertised, and most popular confections—a famous gum and a famous candy. During 1928 alone, $7,500,000.00 will be spent to advertise them.

STEADY HIGH EARNINGS

Because of their enormous demand, monthly sales in vendors are steady and large. Practical chains, consisting of from 200 to 1000 vendors, which can be easily serviced by one man or woman, show net earnings of from $2,820.00 to $13,800.00 yearly.

The operation of a chain of Hoff Vendors requires no previous or special training. No waiting for customers. Earnings start the day a vendor is placed on location. It is a business that can be run right from your own home.

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More than 70 individuals now have established chains of Hoff Vendors. They have been in operation for from one to ten years. There is right now an opportunity for several hundred thousand more vending machines.

If you are looking for a business of your own that is safe, profitable, and permanent, write today for full details concerning the Hoff system of penny vending. Our book entitled "1000 Hoff Vendors and Financial Independence" gives the full facts. It tells where vendors can be located, cost of machines, cost of gum and candy, average daily sales, and the permanent profits that can be yours. In back of Hoff Vendors stands a five million dollar corporation ready to give you every possible assistance with your chain of vendors. Write for the book today. Just use the coupon.

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Industries From Atoms

(*Continued from Page 72*)

"Insatiable curiosity, the essential of scientific research, has given way under modern education methods to cock-sureness," said Dr. Gerald L. Wendt, of Pennsylvania State College on the same subject.

"The enormous amount of knowledge, accumulated by science and taught to students, is giving many the impression that everything has been discovered. Thus they develop a pride in what they do know and lose that insatiable curiosity essential to further scientific progress. The instruction now given in all our schools from kindergarten up is designed to drill into the minds of the students what we now know and to give it to them in the shortest and most condensed form.

"Too often the good student is one with a mind like a catalog or an encyclopedia. He does well in school but he does not realize that, when he enters his profession, what he will have to deal with is not so much things that are known, as entirely unknown factors. The colleges are therefore turning out too many men who have a store of knowledge but little ability to think and not enough imagination to attack the great problems not only in science but in political and everyday life."

The Microscope in Chemical Analysis

DESTRUCTION of an invaluable Della Robbia terra cotta in a Cleveland art museum was recently prevented by prompt application of microchemical analysis, according to Dr. H. S. Booth of Western Reserve University addressing the Institute of Chemistry of the American Chemical Society.

"Without microchemical methods of analysis the cause of the scaling of the surface of this very valuable art piece could not have been found without seriously marring it," Dr. Booth said. "However, with the aid of the microscope and a very small chip that had fallen off the surface, it was possible to find the cause in a few minutes and still keep the little piece intact to be replaced after the cause of scaling had been removed.

"By looking at the fragment of glaze through the microscope, minute crystals were found which had been formed under the surface by the evaporation of moisture from inside the piece. The trouble was caused by a very humid season, in which moisture had been freely absorbed into the body of the porus terra cotta, followed by the evaporation of this absorbed water bringing impurities in the clay to the surface during a very dry season.

"The fault was corrected by forcing the absorbed moisture to evaporate from the back of the piece, where it could cause no damage, by blowing air upon it with a fan and by protecting the glazed surface with a transparent water-proof coating."

Characterizing newly developed methods of using the microscope as "time, labor and money savers," Dr. E. M. Chamot of Cornell University pointed out to the Institute that invaluable information has been revealed by their use about such diverse and important materials as silk hosiery, road surfaces, talcum powder, rubber fillers, polishing powders, minerals and many other substances.

"Counterfeits of antiques and antiquities of all sorts can be detected by mi-

crochemical analyses. These methods enable the expert to make analyses without any injury to the material. They can be applied particularly to ancient ceramics, pottery and porcelain, to paintings by the old masters, to coins, to bronzes and numerous others. It is also possible by these methods to determine the authenticity and the approximate age of documents, illuminated manuscripts and paintings without injuring them in any way. Within the last few years these methods have come to the fore, particularly in our museums, and many fraudulent, worthless articles have been discovered which had been carefully treasured as genuine pieces of great value.

R. E. Rodes, left, inventor of the device for supplying oxygen to the interior of a vault in an emergency, is giving instructions for manipulation of the apparatus. See below

"A coin, for instance, can be subjected to a complete chemical analysis under the microscope without injuring it in any way. The minute sample required for this use is obtained by rubbing the coin over a piece of ground glass which removes an amount too small to be noticed on the coin but enough for such analysis."

The emergency arrives. The soda-lime has been spread around so as to absorb the carbon dioxide in the air, and the girl at the right is turning on the oxygen supply

SIMONDS
SAWS FILES KNIVES STEEL

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SIMONDS Saws have so much greater wearability—so much longer life—so much more value—that the country's leading manufacturers of electric hand saws and portable rigs, now supply Simonds Saws in order to insure the performance of their products. When ordering your next "electric" or portable rig, specify Simonds "60" for economy.

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Johnson Wax Polishers are sold largely to dealers who rent them out. In rental service the motor is subjected to severe wear and tear in the hands of new and inexperienced operators every day.

Even under these extreme conditions the service cost, on over one hundred thousand machines, many of them more than three years old, has been exceedingly low.

Dumore motors have established many such exceptional performance records, in several lines of industry, because

Through long experience in universal motor building the best construction methods have been developed.

All material used is carefully selected.

Extreme precision in manufacture is maintained.

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The Back Yard Astronomer

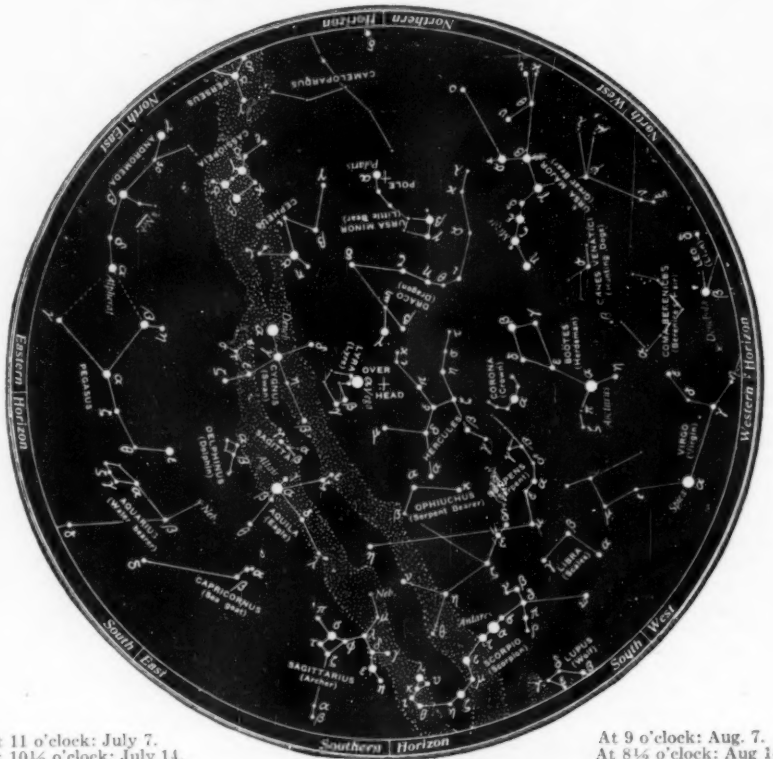
(Continued from page 74)

TIFIC AMERICAN goes all over the world and "A. T. M." has been sent to practically every foreign country.

Just about two weeks after you receive this issue the regular annual get-together of telescope enthusiasts will be held at "Stellafane," Springfield, Vermont. This meeting is just the reverse of exclusive—everybody comes, brings his work if he can and spends a couple of days and a night communing with other souls who have made, are making or hope to make, a telescope. This will be the third of these conventions and the previous two have been a howling success—at least nobody got any sleep. Enthusiasts motor to Springfield (there is, however, a railroad) from several states and last year real telescope fanatics journeyed 1000 miles in order to be present. Whatever sleep you may miss, you will certainly get enough to eat, for the Springfield telescope makers have a member who is a real cook. Come! Write for information—*A. G. I., Tel. Ed.*

The Heavens in July

BY PROF. HENRY NORRIS RUSSELL, Ph.D.



At 11 o'clock: July 7.
At 10½ o'clock: July 14.
At 10 o'clock: July 22.
At 9½ o'clock: July 30.
At 9 o'clock: Aug. 7.
At 8½ o'clock: Aug 14.
At 8 o'clock: Aug. 22.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on July 7, etc.

NIGHT SKY: JULY AND AUGUST

MERCURY is a morning star this month and is best visible about the 21st, when he is farthest from the Sun (20 degrees) and rises an hour and a half before sunrise.

Venus passes through conjunction with the Sun on the 1st, and therefore is an evening star apparently very near the Sun, although really about 70,000,000 miles behind it. By the end of the month she may be seen low in the twilight, but not easily.

Mars is in Aries and still counts as a morning star, although he rises between midnight and 1 A.M. He is brighter than the first magnitude and already a conspicuous object.

Jupiter is in the same part of the sky and the two planets are in conjunction on the morning of July 4th when they are separated by only 18 minutes of arc—little more than half the Moon's apparent diameter. This will be a pretty conjunction, worth getting up to see. Mars will be south of Jupiter and only about a tenth as bright.

Saturn is well placed for observation, in Scorpio, and comes to the meridian about 9 P.M. in the middle of the month. His rings appear opened out at their widest angle and he is one of the most interesting of telescopic objects.

Uranus is in Pisces and comes to the meridian about 5 A.M.

Neptune is in Leo, observable, if at all, only after sunset.

The Moon is full at 10:48 P.M. on the 2nd, in her last quarter at 7:16 A.M. on the 10th, new at 11:35 P.M. on the 16th, and in her first quarter at 9:35 A.M. on the 24th. She is nearest the Earth on the 14th and farthest away on the 26th. During the month she passes Uranus on the 9th, Jupiter and Mars on the 11th, Mercury on the 15th, Venus on the 17th, Neptune on the 19th and Saturn on the 28th.

The Scientific American Digest

(*Continued from page 67*)

greater extinguishing effect than those without oxygen."

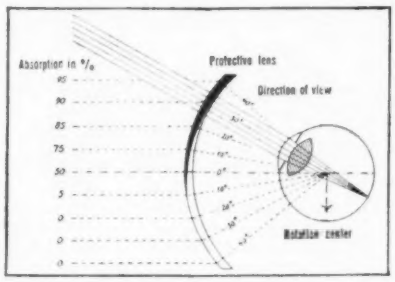
Mr. Thomas stated that the results of this discovery are now being utilized commercially in one and three quarter gallon fire extinguisher that has been passed by the Underwriters Laboratory of Chicago.

This compound puts out an artificial fire built by Underwriters Laboratory in from nine to 12 seconds, while with standard soda-acid extinguisher the shortest time is from 35 to 45 seconds.

Shaded Motor Goggles

CARL ZEISS, INC., of Jena, Germany, whose reputation as a maker of optical lenses and scientific precision instruments using lenses is world-wide, recently announced from its New York City office, new motor goggles in which is incorporated a distinctly new feature. The glasses are shaded gradually from the top down, but are clear in the bottom portion so as to shade the eyes and yet give a wide, clear field of vision.

In the upper portion of each glass a wedge-shaped lining of colored glass is



Sectional view of the new motor goggles showing position relative to eye, and the light absorption

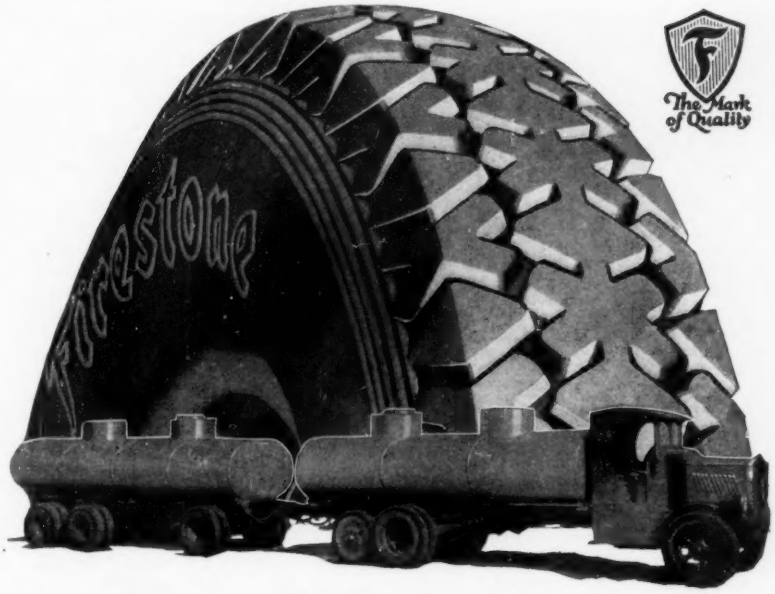
fused in, thus giving the glasses a grey-brown tint at about the center which deepens toward the upper edge. At the latter point, about 95 percent of the light is absorbed and only about 5 percent reaches the eye.

The color wedges are of the well-tried umbral tint. This does not falsify the natural coloring of objects. Thus the motorist may wear these goggles by day or night—in the first case protecting his eyes from glaring sun, and in the latter, from the beams of approaching cars. By slightly inclining his head, the user can shield his eyes as much as he wishes, or as much as is necessary under varying conditions.

Government Furnishes Free Fish—You Raise Them

OFFICIAL encouragement for small private fish nurseries is offered by the government, in order to give a better start in life to the millions of young fish needed to meet the needs of millions of American anglers. The scheme for co-operative nurseries was outlined recently before the National Game Conference by G. C. Leach, chief of the division of fish culture of the United States Bureau of Fisheries.

Co-operation by private owners of suitable bodies of water is being sought, Mr. Leach stated, because young fish reared to a length of four or five inches before they



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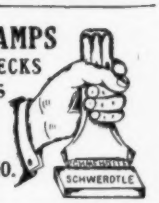

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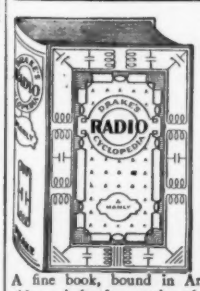

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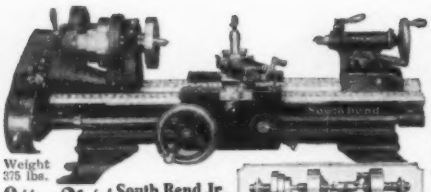

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are turned loose to shift for themselves, stand a much better chance of growing up into lusty trout and bass that will give an angler a run for his money than they would if launched as tiny "fry." Since government-owned hatcheries are of limited capacity, the necessary feeding ponds can not be provided except by private enterprise.

"Scattered over the country are hundreds of springs, brooks, reservoirs, ponds, etcetera, which are perfectly suited to the rearing of fish from fry to fingerlings, or larger," said Mr. Leach. "These are not available for operation by the bureau, but local parties desirous of improving fishing can take them over, make necessary improvements, and establish a fish nursery. They are provided with the initial stock of small fish, and are expected to stand in the role of foster parents of these fish until they are ready to distribute six months or a year later. This constitutes the kernel of the co-operative fish-cultural plan.

"The advantages of the scheme can be readily seen. The sportsmen have at hand a stock of fish whose number and size are known. Incidentally they generally receive much more generous allotments for stocking a nursery than could be furnished under ordinary application. While they are put to the expense of maintaining the nursery and caring for the fish, they would directly or indirectly bear a portion of this expense anyway, and frequently local conditions permit the rearing of fish in a private nursery at a reduced cost.

"Further advantage to the sportsmen lies in the fact that they can distribute fish at their leisure and are not forced to the hurried dumping which is the case when a shipment of fish is received from the hatchery and must be planted within a few hours. The distribution may be spread over several weeks and based upon a well thought out plan so that every stream may receive its quota of fish."—*Science Service.*

Herding Reindeer By Airplane

NEW uses for the airplane are being found almost every day. The latest, and perhaps the most interesting from an economic point of view, is that of herding reindeer in Alaska, where Uncle Sam is breeding a huge meat supply for the future. Ralph Lomen, pioneer of the Alaskan reindeer industry, says that it is not practiced regularly, but that it seems feasible. "Our head herdsman," said Mr. Lomen, "went out recently in an airplane and accomplished as much in two hours as would have otherwise required a week with six men."

Elevator Service In Smoke Stacks

MAN-CARRYING elevators inside 225-foot smoke stacks are features of the new million-kilowatt-capacity East River generating station being created from the existing plant. Seven smoke stacks will tower above the roof of the power house. They will each be 22 feet in diameter, constructed entirely of steel plates riveted together.

Heretofore the inside of steel smoke stacks have been lined with brick, because moisture, gathering where the plates are riveted together, causes corrosion and destroys them. But the designers of the East River station decided that a brick

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lining was not necessary. Instead, they had the inside of every seam in each stack welded smooth, to allow no place for moisture to gather. Thousands of linear feet of welding protect the vulnerable places where plates are joined together.

The elevators permit thorough and safe inspection of the insides of the stacks. Each elevator consists of a steel platform running along guides and suspended from a cable over a sheaf at the top of the stack. When not in use, the elevators rest at the bottom of the stacks below the openings in the sides where the smoke enters from the boilers.

Steel ladders are built outside the stacks to provide another means of ascent. The workmen climb between ladder and stack, rather than outside, since this gives them a feeling of security.—*Science Service.*

"Siamese" Twins Joined at Head

TWO-HEADED monsters abound in legend and story, but Guy's Hospital, London, has a unique record of twins with but a single head.

Twin girls joined at the tops of their respective skulls were admitted to the hospital when they were four days old. In spite of the continuous skulls each acted independently of the other, one being able to sleep while the other cried, according to Dr. H. C. Cameron, physician in charge of the children's department of the hospital, who reported the case to the medical journal, *Lancet.*

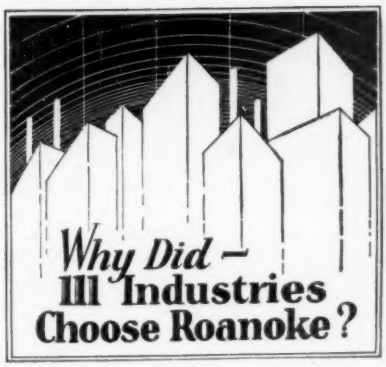
The long axis of the joined babies was not on the same plane, so that when number 1 was laid flat on a bed, number 2 howled lustily until the mattress was inclined so that a comfortable position was reached. Since from the nature of their deformity the children would always have to recline, thus becoming a ready prey to infection, and since one was failing rapidly, it was decided to try to save the stronger by separation. Unfortunately, however, it was found on operation that the cerebral spinal fluid was continuous in the two crania so that death resulted instantly.—*Science Service.*

Patriarchal "Ages" Were Ages of Tribes

METHUSELAH did not live 969 years. The clan or tribe he founded lasted that long, bearing his name until it died out or was absorbed into another primitive tribe. Similarly, Adam's individual age was not 930 years; that was the "lifetime" of his tribe.

This suggested explanation of the apparently unnatural ages of the Biblical patriarchs was advanced before the American Philosophical Society at its annual meeting in Philadelphia recently by Robert P. Field. Mr. Field was led to this hypothesis by a parallel case which has been more fully elaborated in Old Testament history. Israel was the name of a person. The tribe he founded was also called Israel, and the name has finally been extended to mean a whole nation or race. In this sense, Israel has lived something like 4000 years, and has beaten Methuselah's record four times over.

According to Mr. Field's interpretation, the apparently advanced ages at which the patriarchs became fathers of their oldest sons were in reality the ages at which the families of these sons left the patriarchal clans to become the nuclei of new clans on



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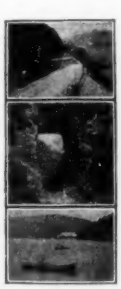

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their own account. Thus Adam did not beget Seth at 130 years of age; Seth was born a good deal earlier, and had a numerous family of his own. What happened during Adam's 130th year was not the birth of a son, but the birth of a clan. Adam *died* at 130, and, at the settling up of his affairs, his eldest son went forth and founded the clan of Seth, leaving the clan of Adam still to flourish for 800 years, until the name finally died out. The same history repeated itself many times, as recorded in the genealogical chapters of the Book of Genesis.

Mr. Field's theory would call for a redating of the Old Testament, and a great extension of the time over the 4004 years allowed by Archbishop Ussher's chronology. Thus the antediluvian period was from 8000 to 10,000 years, and the postdiluvian period from 4000 to 6000 years. Abraham is dated 2090 B.C. and the Flood between 9000 and 6500 B.C., while Adam lived at about 20,000 to 15,000 B.C.—*Science Service.*

Body Metabolism Believed Same in All Races

BODY metabolism proceeds at practically the same rate, be its exterior covering black, white or brown. This conclusion was announced at the American Philosophical Society in Philadelphia recently by Dr. Francis G. Benedict and Morris Steggerda of the Nutrition Laboratory of the Carnegie Institution of Washington as the result of the study of several races.

Measurements made on some Chinese and Japanese students and also at Mount Holyoke College, said Dr. Benedict, indicated a very low rate of metabolism which was at first attributed to some racial factor. Further studies, however, made in the island of Jamaica on brown and black individuals, showed that their metabolism was essentially the same as that noted in whites in the United States. The tropical climate apparently did not produce any appreciable effect.—*Science Service.*

Enormous Fossil Bird From Wyoming

THE prehistoric rocks of Wyoming have yielded up parts of the skeleton of a huge flightless bird that lived on this continent many hundreds of thousands of years ago. The fossils were found last summer, but their discovery was announced for the first time recently before the meeting in Philadelphia of the American Philosophical Society, by Professor William J. Sinclair of Princeton University.

The bird was similar to other giant extinct birds found on this continent, but constitutes a new genus, which has been named *Omorhamphus.* It had no wings, and was a ground-dweller like the modern ostrich. Instead of the specialized club-like toes of the ostrich, however, it had more primitive feet with short curved claws. In some respects it resembled the moa of New Zealand, which became extinct during the memory of the native tribes of those islands.—*Science Service.*

Working as College Course Popular Education Method

WORKING in an industry while studying engineering is becoming a popular method of higher education in America, Prof. W. H. Timbie of the Massachusetts

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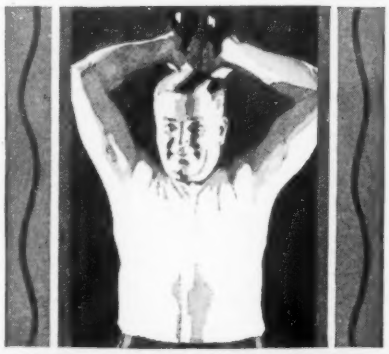

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Institute of Technology told the National Education Association recently.

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"Industry also appreciates the better training which the co-operative students receive, as is evidenced by a study of the positions held by graduates of the co-operative courses in electrical engineering at the Massachusetts Institute of Technology. This study shows that the average salary of these graduates increases at a rate 55 percent faster than that of the average engineering graduate of the country."—*Science Service.*

New Ship's Boom

A NEW ship's boom, or crane, invented by a Portland, Oregon, man, is modeled after the booms used in the construction of tall buildings and has several advantages over old styles.

Due to its long reach, it may be used to load two or three holds at one time. Hitherto a hoisting engine was necessary for each of several shorter armed booms, an engineer was required for each of these, and the booms were often at rest while loads were being stowed properly. One man operates the new boom, which can be operated continuously because while cargo is being stowed in one hold, loads can be lowered into others.

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When a ship is being loaded from railroad flat cars, switching charges may be reduced by the use of this boom since its long arm will reach over the cars on four tracks. Spotting of cars on one track next to the ship is unnecessary.

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G. B. Banks, Prof. Physical Science, Niagara Univ.

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For Sale by SCIENTIFIC AMERICAN

Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

A Design Is Not a Product

THE new type of molded inlaid linoleum floor covering which looks like vari-colored tiles is familiar to everyone. It is made with a press upon which suitable ribs have been placed. This press is applied before the linoleum is cured.

The Armstrong Cork Company, which owned the patent for making it, recently sued the W. and J. Sloane Manufacturing Company for infringement. The defendant's contention that the patent was invalid was upheld.

"Molded inlaid linoleum having a varicolored pattern is old in the art," Judge Bodine, of the New Jersey Federal District Court, rules. "The novelty, if such there be, is in depressing the lines around the design.

"As to the method claims, there seems no patentable novelty. A depressed design upon leather, wallpaper and countless other materials is, of course, obtained by hand pressure or machine, when the article upon which the design is to be placed is in a somewhat softened or plastic condition. That is all the patentees do.

"The leather upon which the bookbinder has depressed a design is still leather. The Florentine and Venetian leather workers, for a long time, have understood the design advantages obtained by using both color and depression to obtain a pleasing result. Books bound in Florence or Venice are books as much as the humble work of the village binder.

"A difference in design cannot make a new product. A new and beautiful design is protected as a design, but its application to an old product cannot make a new product."

Patents in Soviet Russia

FINDING it necessary to progress that inventors be encouraged, the Union of Russian Soviet Republics have been operating a patent system with increasing success for more than three years. The patent laws are patterned largely after those of Germany, with which country the Soviet Union has a special patent agreement. Russia does not belong to the International Patent Convention.

Patents are issued to foreigners the same as to Soviet citizens; they also may be granted to corporations when it is difficult to determine the work of individual inventors in industrial organizations. The term of a patent is 15 years and there is no filing fee. Taxes are paid only after the invention has been exploited. After five years the inventor must show that he is working his patent; otherwise he may be obliged to license other persons to work it. The inventor may lose his patent if it is proved that he is using it only as a means of keeping the invention out of general use.

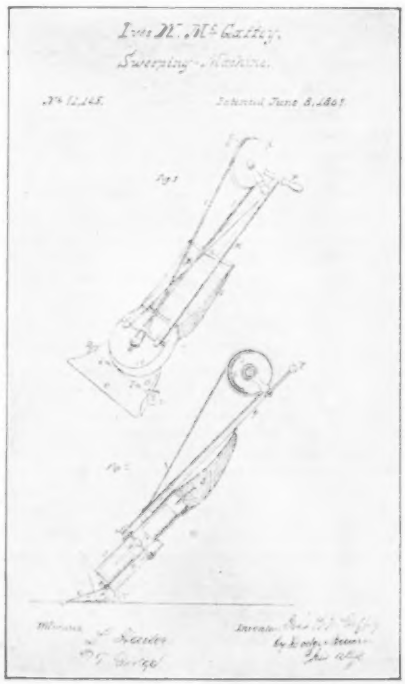
In the last three years 22,023 patents were issued by the Russian Patent Office. Of this number 3938 were filed by foreigners. Germans applied for 2666 of these, Americans for 245, Englishmen for 210, Dutchmen for 170, Swedes for 137 and Austrians for 109.

In the same period of time 3876 applications for registration of trademarks were received. Of these 1779, including 891 of foreign origin, were registered.

The Original Vacuum Cleaner

ADVERTISING has so accustomed us to various names in association with universally used inventions, that the names of the real originators often are unknown to us. Who invented canned vegetables, the electric flat iron, or safety pins? It would be interesting to know.

Take the vacuum cleaner, for example. Did you know it goes back to 1869? The earliest patent we have been able to locate was issued in June of that year to Ives W. McGaffey, of Chicago. The term "vacuum cleaner" had not yet been devised and the



"Dust and dirt in dwelling houses is a source of great annoyance to all good housekeepers," said the inventor in his patent application

inventor called his device an "improved sweeping-machine." In his patent specification, McGaffey explained it as follows:

"The accumulation of dust and dirt in dwelling-houses is a source of great annoyance to all good housekeepers, a large portion of the dust being so light that the ordinary process of sweeping sends it flying into the air, so that it is difficult to control or expel it from the room. The use of a broom or brush on carpets is objectionable, for it wears off the lint and fiber in fine particles, and creates a cloudy dust, while the heavier particles are brushed down into the carpet.

"To obviate these difficulties is the object of my invention, the nature of which consists in the employment of a strong current of air, produced by mechanism, and so controlled as to take up the dust and dirt, and carry the fine particles into a porous air-chamber, so constructed as to allow the air to escape, while the dust is retained."

A grooved wheel or pulley was fixed on the handle near the end. This was turned by hand, a rope turning a smaller pulley on the end of a fan shaft. The air to supply the fan-blast was admitted through a passage which widened out at its front and tapered down, so as to receive the air in a broad thin sheet. The dirt was caught in a cotton bag very much like those on the machines in use today.

Cuckoo Trademarks

SOMETIMES a manufacturer will adopt a particular trademark because he hopes to cash in on the good will built up by another manufacturer who uses a similar trademark. Such a manufacturer is likened, by Judge Hutcheson, of the Federal Court for the Southern District of Texas, to the cuckoo bird, whose well-known idiosyncrasy it is to lay its eggs in some other bird's nest.

The judge's remarks are elicited in his decision enjoining the Listerated Company from using the trademark "Listerated" on hair tonics and dandruff remedies. Action was brought by the Lambert Pharmacal Company, which has been using the trademark "Listerine" since 1881. The originator of the Listerated product said he adopted the trademark because he saw the word on chewing gum. A druggist had told him that "he had better put some Listerine in his preparation or Lambert would get him," and that thereafter he put some Listerine in his product.

"In addition to the views expressed that the use of the word 'Listerated' is a technical, statutory trademark infringement," says Judge Hutcheson, "I think the evidence amply sustains plaintiff's contention of unfair competition, and that only a blind man can fail to see that defendant has deliberately set out to pirate plaintiff's reputation and its name; to reap where it has not sown, and like the cuckoo, to lay its eggs in the nest of another bird.

"With the entire field of unappropriated names open to it, it selected the name 'Listerated' because it knew that the very word carried with it a suggestion of prophylactic cleanliness, and that this suggestion had been created for the word by plaintiff's advertising. Such a practice cannot be too vigorously condemned.

"Plaintiff insists, and I agree with plaintiff, that defendant's tonsorial infant, conceived as it was in business iniquity, cannot be cleansed of its original sin by the simple device of sprinkling over each bottle of it, ten drops of Listerine, pro-

phylactic and cleansing as they are, but that what is needed here is a true regeneration, with a new christening under a new name."

"Inventions Wanted"

MEN who would be inventors frequently write to us asking what to invent. They are inventive, they tell us, and if only someone would tell them what to originate they would set to work and originate it. From time to time lists of inventions wanted appear. The best known of these is "What's Wanted," assembled by the British Institute of Pantentees. A few of the items listed will give an idea of the nature of all of them:

A motor engine which does not need de-carbonizing.

A silent lawn mower.

An invention that will transmit the words spoken into a receiver to a typewriter, which will automatically reproduce.

A sign-writer's brush which can be loaded with a fair amount of paint to save dipping in pots for almost every stroke taken.

A means of producing electrical energy in reasonable quantities other than by mechanical motion.

A photographic negative which can be developed in daylight.

Something to prevent fluff under beds.

A bath-room bolt which can be bolted from the inside but which, in the case of emergency, could be quickly released by pressing a button at the bath, at the same time ringing an emergency bell.

An unpuncturable pneumatic tire.

A magazine hammer which will supply a nail every time the hammer head is struck on the job and drive the nail with one blow and with the use of one hand only.

The transmission of speech by light.

An onion peeler which will do away with the watering of the eyes of the person peeling the onion.

Some of the things called for already are in use. Even so, of what use are such lists? The originator, Sir William Bull, believes they are largely inspirational. "Many discoveries," he reminds us, "were made during the long medieval and apparently (I say, apparently) hopeless search for the Philosopher's Stone."

Our observation has been that a definite economic need is at the bottom of every successful invention. There often is more ingenuity required, we believe, in finding exactly what to invent than there is in actually making the invention.

One Form of Protection Only

WHEN a man originates a new design or device he sometimes has a choice of methods of protection. For example, it is possible that the same emblem could be protected as a commercial print, a label, a design, or a trademark. Having chosen which form of monopoly he desires, however, the owner cannot later elect another form so as to give his monopoly a longer life.

This principle is well illustrated in the recent application of Ernest Blood for a design patent for a hosiery ticket. The application was rejected on the ground that previously he had registered the same design as a label. In upholding the decision of the Examiner, the Commissioner of Patents declares:

"There is no difference in contemplation of law between the label-design and that involved in this proceeding; the design in each case is the same. The design is not entitled to double registration, once as a label-design and again as a design for a hosiery ticket. Such a course would result for all practical purposes in an extension of the design monopoly.

"The applicant was entitled to apply for a patent for the design as a hosiery label, or he might complete the label and register the design, so completed, as a label. He could not do both. He elected to pursue the latter course, and has obtained the protection thereby assured to him, and he is bound by that election."

In Praise of Research

WE hear much of the immense amount of research work done by great manufacturing corporations. The question arises: Who pays for it? How and why the ultimate consumer bears the cost was explained recently by Albert K. Davis, vice-president of the General Electric Company in charge of its patents. In a formal statement to the United States Senate Committee on Patents he said in part:

"One of the greatest benefits of the patent system is that it makes possible the development and commercial introduction of inventions. A striking illustration is the Curtis steam turbine, which is today developing a large part of the electric energy used in this country at a great saving in fuel.

"Before Charles G. Curtis brought this matter to us he had, I am informed, been obliged to spend large sums of money in experiment and development. We took it up and worked on it for years, and before we had received a dollar of profit we had invested in it over 3,000,000 dollars, which was a very substantial part of the capital of the company in those days.

"The only way we could get this money back was by adding a 'development charge' to the cost of the turbines, which we thereafter built, until that 3,000,000 dollars was liquidated. If it were not for the patent system our competitors could have copied our turbines, without spending any substantial sums in development, and could have undersold us.

"There are some inventions which can be developed and exploited by the traditional poor inventor, to whose exertions the world, as we all know, owes a great deal. But it is becoming more and more the case, as the demands of modern civilization increase, that inventions require the expenditure on development of sums of money greater than any ordinary inventor can hope to supply by his unaided efforts.

"If he goes to capitalists to ask them to furnish the money for the development, the only thing that he has to offer is the probable profits from the patent. If he goes to a manufacturing company and tries

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Aeronautics

FLYING MACHINE—Of the helicopter type, equipped with two oppositely rotating propellers mounted as a unit to lift the machine directly upward, for a take-off, as well as the usual propeller for forward movement. Patent 1665091. W. H. Goyne, 1011 2nd Ave. East, Tillamook, Ore.

Pertaining to Apparel

KNIT SCARF—Wherein the edge at the sides and ends, is tightly knit, and the center is of loose knitting in imitation of hand knitting. Patent 1666819. A. F. Goetz, c/o Morgan Knitting Mills, 577 South 10th St., Newark, N. J.

SLIPPER—Wherein an ornamental edge is provided at the junction of the sole and upper, whereby the stitching used in the sole is protected against ordinary wear. Patent 1667629. H. Friedman, 33 34th St., Brooklyn, N. Y.

DEVICE FOR SUPPORTING TIES—Made of wire and acting as a spring, secured on the shirt collar stud, for receiving a tie, without any portion of the device appearing. Patent 1567679. J. Roura, c/o C. Chassevent, 11 Boulevard de Magenta, Paris, France.

SQUARE FOR DESIGNING GARMENT PATTERNS—Which will present usual measurements, and in addition designs for both the body and sleeves, and the position of the construction lines on a pattern. Patent 1667646. A. Gingali, 67 W. 46th St., New York, N. Y.

Chemical Processes

PAINT—Composed of finely powdered carbide sludge, coloring matter and linseed oil, will withstand relatively high temperature and may be used on wood or metal. Patent 1664341. L. M. Wise, 201 Erie St., McKeesport, Pa.

Designs

DESIGN FOR A HOLDER FOR A FOUNTAIN PEN OR THE LIKE—Patent 74802. H. B. Quain, 382 No. 16 St., San Jose, Calif.

DESIGN FOR A CURTAIN-POLE END OR SIMILAR ARTICLE—Patent 74781. J. O. Crawford, c/o John Kroder & Henry Reubel Co., 107 E. 17th St., New York, N. Y.

DESIGN FOR A SHOE—Patent 74789. T. J. Fitz Harris, c/o Franklin Simon & Co., 38th St. and 5th Ave., New York, N. Y.

DESIGN FOR A DOLL—Patent 74720. G. Gormany, 1908 Shattuck Ave., Berkeley, Calif.

DESIGN FOR A CURTAIN-POLE RING—Patent 74721. J. O. Crawford, c/o J. Kroder and H. Reubel Co., 107 East 17th St., New York, N. Y.

DESIGN FOR A CURTAIN-POLE BRACKET—Patent 74722. J. O. Crawford, c/o J. Kroder and H. Reubel Co., 107 East 17th St., New York, N. Y.

DESIGN FOR LACE—Patent 74817. B. A. Ball, c/o American Textile Co., Pawtucket, R. I.

DESIGN FOR A SIGNAL LAMP—Patent 74859. I. Alexander, 643 East 182 St., New York, N. Y.

to get it to exploit the invention for him, the patent again furnishes the only hope which the company has of getting its money back.

"I am persuaded that the benefits to the public due to this result of our patent system are much greater than is generally realized."

Altering a Patented Machine

TO what extent can a manufacturer alter a machine? An unusual phase of this frequent question arose recently in the suit in which Judge Lowell in the Massachusetts Federal District Court held that the George Close Company did not have the right to change a caramel wrapping machine which it had purchased from the Ideal Wrapping Machine Company in order to accommodate larger-sized caramels.

The patent sued on covers a machine for wrapping small cubes of candy. It wraps 200 caramels a minute, which is more than double the output of any prior machine. Its two main parts are a cutter table and a wrapping wheel. The cutter table is a circular disk with knives at fixed intervals. The wrapping wheel is a vertically revolving disk with pockets to receive the severed pieces of candy.

The particular machines used by the George Close Company were guaranteed to wrap pieces of candy 1 by 1 by ⅜ to ¾ inches at the rate of 200 per minute. After the company had been selling candy for some years, it found that its market was seriously interfered with by a piece of candy 1¼ by 1 by ¾, which was manufactured by the Ideal Caramel Company. Application was made to the manufacturer of the wrapping machines to change them over to wrap candy of the larger size, but this the manufacturer refused to do. (It developed that two of the officers of the machinery company had bought a controlling interest in the Ideal Caramel Company, which proceeded to wrap candy of the larger size.) The Close Company had the necessary alterations done by a machinist.

"The rights of a buyer of a patented machine have been settled by a long line of cases," Judge Lowell finds. "He may use it until it wears out, and may repair it also; he may not, however, rebuild, or, as it is usually called, 'reconstruct' the machine. Difficulties arise in determining the legal limits between repair and reconstruction. The test is whether the identity of the machine is preserved by the repairs. If they are so extensive that the result is a new machine, the legal limit has been passed and the forbidden realm of reconstruction has been invaded.

"If we test the case at bar by the criterion of identity we shall find that the machines lost their identity and became different machines, as they were so reconstructed as to be capable of wrapping an entirely different size of candy from that which could be wrapped by them when in their original condition."

In Praise of the Patent System

EDWIN J. PRINDLE, president of the New York Patent Law Association, recently made an address in which he declared that in a large measure the tremendous strides forward which civilization has taken since the end of the 18th century is due to the American patent system. He said in part:

"Because of the increased productability which the American inventor has made possible, the average American workman has an attractive home, electric lights, a bath, an automobile, a radio and a victrola; and he has the leisure to enjoy them, and this is so notwithstanding that he has to compete with cheap labor abroad.

"At least two concerns in this country spawn automobiles like fish, at the rate of several thousands a day, and each more complete, automatic, and convenient than the best car that money could buy a few years ago, either here or abroad.

"In a recent article by Examiner W. I. Wyman, of the Patent Office, he enumerated the principal inventions produced by Americans in the various single decades since the establishment of our patent system. In the decade from 1840 to 1850, there were produced the reaper; vulcanized rubber; the sewing machine; and the telegraph, inventions all of incalculable value.

"From 1880 to 1890, the inventions of the first importance produced by American inventors are too numerous to enumerate here. I mention only the following: the wax phonograph record; the Westinghouse quick-acting air brake; the Janney car-coupler; the transparent photographic film—forerunner of the movie; the recording adding machine; the linotype type-bar casting machine, which greatly reduced the cost of printing; the single-type composing machine, setting the individual type themselves; the half-tone process of printing pictures in books and newspapers, almost universally used; the Tesla split-phase induction motor; the automatic knot-tying harvester—replacing 7 out of 8 men; the incandescent light; the transformer; the steam turbine; the electric furnace; the polyphase electric motor; the cash register; the trolley car; and electric welding.

"Although Americans are all of European stock, and therefore are not naturally more inventive than Europeans, yet, it is a fact that more than two thirds of all the inventions of primary importance which have been made since the establishment of our patent system were produced by American inventors. Of the wonderful development which I have outlined, but a small part would have occurred, if it had not been for the inducement of the American patent system.

"I, therefore, express my profound belief that our patent system has been the primary factor in making the United States foremost among the nations in agriculture, inventing, and manufacturing. While, of course, there were other factors, the patent system was by far the most potent one.

"The American patent system is the most marvelously effective economic instrumentality ever devised by man. It is producing inventions at such a rate that we more than half expect to see an announcement of a new invention every time we open our morning paper.

"We, therefore, who are engaged in its administration, may feel that we are taking part in one of the most vitally important activities of our political economy, and may derive corresponding inspiration and satisfaction from our work.

"And because that instrumentality has such wonderful results, let us lawyers guard it from any experiments with changes in its principles, and confine attempts to improve it to matters of simplification of procedure."

DESIGN FOR A CURTAIN-POLE BRACKET OR SIMILAR ARTICLE—Patent 74864. J. O. Crawford, c/o John Kroder & Henry Reubel Co., 107 East 17th St., New York, N. Y.

DESIGN FOR A JEWELRY SETTING—Patent 74888. F. C. Joseph, 1316 Morris Ave., New York, N. Y.

DESIGN FOR A COMBINATION CONTAINER AND PICTURE FRAME—Patent 74889. H. A. Kretschmer, 401 No. Leavitt St., Chicago, Ill.

DESIGN FOR A BOOK-END OR SIMILAR ARTICLE—Patent 74955. T. S. Woodward, Leetonia, Ohio.

Electrical Devices

ELECTRICAL DOUGH-IMPRINTING MACHINE—For the imprinting of dough blanks prior to baking, the dough being placed in biscuit sized pockets and the dies mechanically brought into contact therewith. Patent 1665196. M. Collis, 165 King St., Charleston, S. C.

VACUUM TUBE—In which a single tube having one filament can be used in place of a plurality of tubes in a multi-stage radio set. Patent 1666833. W. A. Rhodes, and D. Bellar, 388 Central Ave., Brooklyn, N. Y.

RADIANT-ENERGY COLLECTOR FOR AERIALS—Star-like elements made from a single piece of copper and attached to an ordinary outdoor antenna to make the same more responsive to electrical vibrations. Patent 1666834. W. A. Rhodes, and B. Bankoff, 388 Central Ave., Brooklyn, N. Y.

VACUUM TUBE—Capable of use other than that of a detector because it is capable of greatly amplifying the electrical signal impulses impressed thereupon. Patent 1666858. A. H. Jahn, 3521 Butler St., Pittsburgh, Pa.

ELECTROMAGNETIC DETECTING DEVICE—A compact apparatus which may be carried around, is highly sensitive, and by which oil lying beneath the earth's surface may be accurately detected and charted. Patent 1665662. C. E. Godkin, R. F. D. No. 1, Box 145, Hayward, Calif.

Of Interest to Farmers

DRAWBAR SHIFT FOR TRACTORS—Which is adapted to be manually shifted particularly when the tractor is plowing on a hillside and turning the furrow down the hill. Patent 1665133. V. L. Gibson, Route No. 1, Salem, Oregon.

BOLL-WEEVIL DESTROYER—A wheeled framework which is movable along rows of plants, an agitator for dislodging insects, and pans of destroying liquid for catching insects as they fall. Patent 1665960. C. A. Heilmann, Skjelskor, Denmark.

HARROW-DISK SHARPENER—And means for supporting a harrow disk in frictional contact with a grinding element in order that the peripheral edge may be sharpened. Patent 1665954. T. Fox, Spalding, Nebraska.

HARROW ATTACHMENT—Including a pair of goosenecks secured to the rear bar of the harrow at an angle, and a blade attached thereto acting as a scraper. Patent 1666778. J. M. Harlan, Dayton, Wash.

CORN-HUSKING MACHINE—For stripping the ears from a row of standing stalks, husking the ears, separating the stripped ears and loose husks, and dumping each. Patent 1666796. H. V. Schuler, Box 391, Spencer, Neb.

GUARD FINGER FOR MOWING MACHINES—Which has means for contacting with its supporting bar and with adjacent guard fingers so as to prevent play or slipping and consequent breakage of blades. Patent 1667627. E. S. Fisher and E. R. Mendrop, Hollandale, Mississippi.

Of General Interest

PORTFOLIO—Or brief case, wherein one or more readily accessible pockets are presented for

holding folders, capable of ready removal, and with means for preventing disconnection. Patent 1663335. L. Danziger, 42 West Broadway, New York, N. Y.

WATER SILENCER—Readily assembled or taken apart, can be attached to any ordinary faucet and will silence and filter the flow of water and prevent splashing. Patent 1663382. S. B. Merkel and E. Dobrowsky, 168 W. 96 St., New York, N. Y.

BREWING UTENSIL—For brewing such beverages as tea, coffee or the like, with means for suspending the substance to be brewed either immersed or above the water. Patent 1664226. A. E. Silver, 8504 76th St., Woodhaven, N. Y.

CHIMNEY CAP—A cap or cowl, whereby the interior of the chimney is protected against rain and foreign matter by inclined deflecting members which cause a draught. Patent 1664315. R. P. Orr, 1091 Parkwood Blvd., Schenectady, N. Y.

COMPACT FOLDER AND EJECTOR—For vanity cases, wherein a manually actuated ejecting spring is utilized to produce a movement of the compact when the catches have been released. Patent 1664301. W. G. Kendall, 118 Market St., Newark, N. J.

CHAIR—A non-folding sheet metal chair so constructed that a number may be piled, or nestled, in direct vertical juxtaposition for storage purposes. Patent 1664356. L. Dellart, 176 Russell St., Brooklyn, N. Y.

SMOKERS' STAND—Associated with an ash tray, for supporting cigarettes, matches or other analogous packed articles, disposed in tiers and different planes to facilitate their removal. Patent 1663601. A. Kappenberg, 4030 7th St., Bayside, L. I., N. Y.

NON-REFILLABLE CARTON—For radio tubes or analogous articles, which protects the tube, and admits the testing of the contents without removal of the carton seal. Patent 1664350. A. R. Cappiello, 96 East Mosholu Parkway, New York, N. Y.

PARTITIONING DEVICE—Capable of a wide range of adjustment so as to provide partitions or compartments in a drawer or other receptacle just the size or shape desired. Patent 1664465. F. A. Purchas, McGraw, N. Y.

GASOLINE-STORAGE-TANK FILTER—For subsurface gasoline tanks, which when coordinated, will make it possible to remove the discharge pipe without digging up or disturbing the surrounding ground. Patent 1665106. A. P. Moran, 139 Main St., Ridgefield Park, N. J.

CANDY BOX—Simulating a log cabin, with lock controlling means for the roof, or lid, and means for starting and stopping a musical box hidden from view. Patent 1664464. F. A. Purchas, McGraw, N. Y.

PROCESS OF MAKING DOUGHNUTS AND OTHER FOOD PRODUCTS—Wherein dough with a suitable amount of shortening is squeezed through a compressible container into a mold, wherein the cooking the shortening forms a thin crust. Patent 1663719. J. Morley, 2706 West View Drive, Los Angeles, Calif.

COMB—In which is formed a groove at the base of the teeth for an absorbent cord, the cord absorbs moisture in drying the hair, and is removable to provide a self-cleaning comb. Patent 1665134. H. H. Hutchings, 220 W. 42nd St., New York, N. Y.

CABLE GUARD—For use on highways or bridges, wherein the cable is so supported that it will prevent vehicles from striking the posts, thereby avoiding danger. Patent 1664321. I. E. Quist, c/o Highways Dept., Warren, Tenn.

SAFETY-RAZOR HANGER—For supporting the razor, carrying new blades in such manner that they are easy of access, and providing a receptacle for used blades. Patent 1663875. R. Doner, 303 Segur Ave., Toledo, Ohio.

JELLY-BAG HOLDER—Including two telescoping rings, between which the marginal section of a bag may be clamped, and suspended therefrom, and means for supporting the rings. Patent 1664658. C. P. Blazer, Sutico, Wash.

POSTING TRAY—Designed for securely holding a plurality of ledger sheets in adjustable and separable vertical position to facilitate reference thereto, and posting thereon. Patent 1663198. C. B. Harrison, 434 So. San Pedro St., Los Angeles, Calif.

MUD-LADEN FLUID FOR OIL AND GAS WELLS—Comprising finely ground iron filings, borings and scale, by which the flow of gas, oil or water can be controlled and the sealing up of well sides effected. Patent 1663492. L. Chamberlain, 2550 East 9th St., Los Angeles, Calif.

JEWELRY CASE—So constructed that when closed the articles will lie flat, and when opened the articles will be moved to an inclined position for display, without removal. Patent 1666001. T. Catala, Hudson Terrace, Englewood Cliff, N. J.

COOKING, FREEZING AND STORING RECEPTACLE—Which provides a dead air, or vacuum, space in the walls and cover, whereby approximately the same temperature may be maintained for a protracted period. Patent 1666012. C. S. Humphrey, c/o Manhattan Can Co., 882 3rd Ave., Brooklyn, N. Y.

EGG HOLDER—For transporting eggs, stamped from a single piece of pasteboard, and provided with means for supporting the egg at the center as well as top and bottom. Patent 1665420. E. E. Pinkerton, 4428 Hermitage Ave., Chicago, Ill.

ARTICLE CABINET—Or rack, for the convenient housing and storage of umbrellas, overshoes, or the like, whereby drainage water is collected while the articles are drying. Patent 1665986. S. R. Side, c/o Rubin 1516 54th St., Brooklyn, N. Y.

SHADE-CORD HOLDER—In the nature of a button, which permits coupling engagement of a shade cord with the shade without knotting or tying the cord. Patent 1665953. W. J. Foster, 2540 Boulevard, Jersey City, N. J.

METAL BASE FOR TIMBER POLES—A cylindrical metal sleeve which fits tightly around the pole below ground to prevent decay, and extends sufficiently above to protect from grass fires. Patent 1665995. A. J. Wiley, Hydraulic Engineer, Boise, Idaho.

WINDOW CLEANER—In which two telescopic sections, with cleaning heads are spring pressed against fabric pads, for simultaneously cleaning the opposite sides of a window pane. Patent 1666060. K. Horihata, c/o M. C. Kauffman, 911 Park Ave., New York, N. Y.

TELLERS' CAGE—For banks, by which a teller is enabled to receive and deliver moneys from his window by a rotatable table thus minimizing injury and possible theft. Patent 1663681. E. E. Cronenweth, 721 East Broadway, Glendale, Calif.

WINDOW CLEANER—A forked frame which supports and clamps cloth-holding elements to the inner and outer surfaces of a pane, for simultaneously cleaning both surfaces. Patent 1666782. J. J. Kilbride, cor. Mountain & Montague Aves, Scotch Plains, N. J.

FLATIRON—Which is co-extensive in length with the width of the ironing board, and may be readily pushed forward onto the piece being ironed, without directly lifting the iron. Patent 1665295. E. D. Campbell, 675 19th Ave., San Francisco, Calif.

Hardware and Tools

COMBINATION WASHING TOOL AND SWAB—Adapted for cleaning the flow surface of a well of drill cuttings, mud, paraffine or other sediment which would retard the production of the oil. Patent 1664283. A. Boynton, 1800 San Pedro Ave., San Antonio, Texas.

DIVIDERS—So constructed that a full length pencil or a small stub will be securely retained in position, and may be rapidly adjusted with one hand. Patent 1663855. J. L. O'Connor, 1 Dermott Court, Portland, Maine.

CASING SPEAR—For pulling casing or pipe from wells, which cannot become jammed in operation, may be released and re-engaged without drawing the tool to the surface. Patent 1664363. W. H. Harvey, Water Valley, Mississippi.

WRENCH—In which the movable jaw, instead of reaching around the shank is secured to one face thereof, which allows of greater freedom in shaping the shank. Patent 1663920. A. W. Peterson, 1533 E. 74th St., Chicago, Ill.

PIPE COUPLING—Which facilitates the connecting of well casing sections, firmly holding the sections at the joints against longitudinal and internal as well as external stresses. Patent 1663702. W. D. Himes, 4109 So. Main St., Los Angeles, Calif.

WRENCH—Which may be quickly adjusted by loosening a wing nut, sliding the jaw, and setting the wing nut, when set the wrench will not slip. Patent 1666879. V. Barton, Cadillac, Mich.

BELT-APPLYING TOOL—Whereby one person is enabled with its aid to engage a heavy belt with a pulley, at high tension, the tool is readily adjustable. Patent 1666789. G. W. Pobanz, c/o Davis & Taylor, Attys, Genesco, Ill.

COMBINED BOLT AND NUT LOCK—Having a locking member adapted to seat within grooves on the bolt and nut, whereby they may be locked without loosening by vibration. Patent 1666608. F. L. Sarazin, Route 1, Dubuque, Iowa.

NAIL SETTER—For holding a number of nails, adapted to be manipulated by one hand for setting, while the other hand is free to drive the nails with a hammer. Patent 1665669. E. F. Malouf, 325 "D" St., Marysville, Calif.

Heating and Lighting

MELTING POT—For melting linotype metals, from which the dross can be readily discharged from the pot, and collected without polluting the surrounding atmosphere with poison. Patent 1664779. L. W. Jones, 108 West 1st St., Los Angeles, Calif.

FLUID-FUEL FURNACE—Having both oil and gas burners, and means for controlling the fuel supply so that the oil and gas burners can be used together or separately. Patent 1663713. H. V. Leahy, c/o Leahy Mfg. Co., 1804 East 8th St., Los Angeles, Calif.

AIR CIRCULATING AND HEATING APPARATUS—Which may be employed in cold weather as a heater, and in warm weather for circulating the air in a room to cool the same. Patent 1666816. P. R. Falk, 30 Gay St., Elmhurst, N. Y.

Machines and Mechanical Devices

WASHER-SETTING MACHINE—For automatically and simultaneously setting an entire series of washers on the pegs in a rubber heel mold, for encircling the nail holes. Patent 1664346. M. G. Bertone, 76 Hazel St., Glen Cove, L. I., N. Y.

PLATE VALVE—Which is rotatably supported, and on which relatively little wear will take place on the contacting surfaces, easily opened or closed against relatively high pressure. Patent 1664306. W. A. Milam, Box 55, Seymour, Texas.

EXCAVATING BUCKET—Wherein reeving of the closing cable is simplified, the entire organization compact, and a diminished height makes it possible to work in close quarters. Patent 1664359. A. Grout, c/o Warner & Sullivan, Sault Savings Bank Bldg., Sault Ste. Marie, Mich.

PROCESS FOR THE MANUFACTURE OF A CELLULOSE PRODUCT HAVING THE APPEARANCE OF WOOL—Which consists in producing cellulose filaments by mechanically drawing a solution of cellulose through a coagulating bath until their molecular stability is assured in undulated form. Patent 1664319. A. Pellerin, c/o C. Bletry, 2 Boulevard de Strasbourg, Paris, France.

PUMP JACK—Which is so constructed and organized as to impart to the polish rod of the pump a true rectilinear movement. Patent 1664364. W. G. and K. R. Jensen, 117 No. Oak St., Nowata, Okla.

APPARATUS FOR SEALING PACKAGES—Which thoroughly cements the entire surface of all open flaps on a carton, and in a single operation seals both the outer and inner wrappings. Patent 1662341. H. Schwarz, 426 Brannon St., San Francisco, Calif.

VARIABLE-SPEED PULLEY—Including a pair of pulleys of radially adjustable segments, and so constructed that the contraction of diameter of one automatically effects the expansion of the other. Patent 1663414. A. H. Mize, c/o Leslie N. Flood Union Bleachery, Greenville, S. C.

CUTTING OR SLICING MACHINE—Especially adapted to produce battery separators from small blocks or waste lumber, also for producing sheet-like veneer stock as used in the construction of berry baskets. Patent 1665131. E. R. Ferrari, Box 45, North Bend, Oregon.

OIL GRATE AND SEAT — Adapted for use in hydraulic oil presses, wherein the oil channels may be increased in size and easily cleaned without removing the seat or other parts. Patent 1665123. W. A. Wilhelm, 2819 Wilbarger St., Vernon, Texas.

FLOW METER—Comprising a multiple-bladed low pitched screw, connected to a shaft acting directly on a recording mechanism for accurately measuring the rate of flow of a stream. Patent 1665141. C. P. Mayer, 420 Westfield Ave., Elizabeth, N. J.

CASING ELEVATOR—For handling oil well casings, a hingedly connected collar securely encircling and gripping the casing eliminating twisting, slipping or other injury in the elevation. Patent 1664461. G. A. Montgomery, Box 2293, Dallas, Texas.

VENDING MACHINE—For wrapped candy rolls, cigars, or other analogous articles, the machine being operable by depositing a coin, and the merchandise vended one at a time. Patent 1665989. W. P. Smith, 292 Park Ave., Newark, N. J.

SAND-TESTER PUMPS—Adapted to be reciprocated in an oil well to remove oil sands for testing, thus eliminating the practice pipe setting and bailing. Patent 1665967. G. F. LeBus, c/o LeBus Rotary Tool Works, Electra, Texas.

PERFORATED CASING—For oil wells, constructed to allow the ready influx of oil from the oil sands, yet protect the casing against the wearing action of the sand. Patent 1664734. D. N. Brundy, 1708 No. Raymond, Pasadena, Calif.

CASTING MACHINE—Which affords facilities for subjecting molten metal to pressure, and at the same time causes an air suction before and during the pressure. Patent 1666843. F. N. Brown, Jr., 407 Mills Bldg., El Paso, Texas.

DERRICK—Having a novel form of gudgeon for the lower end of the mast, and also coordinating means to guide the hoist cable at the mast top. Patent 1666857. F. Hunt, 941 East 156th St., New York, N. Y.

Medical Devices

STRESS BREAKERS—A coupling device which connects a tooth engaging member with the artificial denture and compensates for the natural movement by a ball and socket connection. Patent 1665975. N. A. Oscher, 274 Livingston St., Brooklyn, N. Y.

Musical Devices

BRIDGE FOR PIANO ACTION—Of such character and design as to permit one to substitute it for the ordinary bridle, should the latter become broken, with accuracy and ease. Patent 1663538. H. E. Chute, 3401 South Flower St., Los Angeles, Calif.

Prime Movers and Their Accessories

CARBURETOR—Capable of not only forming an economical combustible mixture with air and gasoline, but wherein the heavier fuels may be employed with equal advantages. Patent 1663724. C. E. Palmer, c/o W. E. Barnhart, 511 Lyon Bldg., Seattle, Wash.

TRANSMISSION FOR SHAFTS—In which no gears are employed, which is noiseless, and will not require any oil for lubrication except the oil required for the shaft bearings. Patent 1664349. G. A. Burrow, c/o M. C. Gray, 1227 Riverside Ave. West, Spokane, Wash.

INTERNAL COMBUSTION ENGINE—In which each cylinder has a single port and means for automatically connecting the single port of each cylinder successively with the intake and exhaust. Patent 1665421. G. H. Roose, 1228 N. Court St., Carrole, La.

Railways and Their Accessories

COMPARTMENT CONVEYANCE CONSTRUCTION—Providing within the width and height limits of a standard car, a plurality of readily accessible compartments, affording separate seating, sleeping, and lavatory accommodations. Patent 1664294. E. Gugler, 101 Park Ave., New York, N. Y.

SPEED-CONTROLLING DEVICE FOR RAILWAY AND TRAMWAY TRAINS—So constructed as to automatically modify the braking action when the pressure of the compressed air of the brakes is inferior to the normal pressure. Patent 1665112. E. Rodolausse, c/o C. Chassevent, 11 Boulevard de Magenta, Paris, France.

AIR-BRAKE VALVE—For a street car or like vehicle having an engineers' valve at opposite ends and a single line connecting the valves and the associated brake cylinder. Patent 1665586. S. J. Evans, Box 624, Princeton, W. Va.

TRIPLE VALVE—Particularly adapted for air brake systems, whereby the auxiliary reservoir is recharged without producing a brake release, whereby prolonged brake application can be effected when required. Patent 1663837. H. Hansen, Box 1252, Bisbee, Arizona.

TANK-CLEANING APPARATUS—For mixing a cleaning fluid with a heating fluid and then forcibly circulating the heated mixture against the inner walls of the tank car. Patent 1666015. G. W. Land, 4015 Olive St., Vancouver, Wash.

Pertaining to Recreation

COMBINED PROTECTIVE AND SIGNALING DEVICE—For use by baseball umpires adjacent the home plate, whereby signals incident to the playing of the game may be disposed from a protected position. Patent 1663358. J. G. Stephenson, Box 582, Celina, Tex.

BASEBALL GAME APPARATUS—Comprising a game board having a surface representing a baseball field, even to the extent of providing ball pitching and ball batting devices. Patent 1662317. G. R. Livingston, 1336 Maple St., Santa Monica, Calif.

PUNCHING BAG—In which the bag structure is carried by a base structure capable of being shifted from place to place, while continually in condition for use. Patent 1665969. D. McNamara, 144 E. 17th St., New York, N. Y.

Pertaining to Vehicles

SIGNAL—In the form of a figure of transparent material, lighted by an electric bulb, from the inside, and adapted for connection to an automobile radiator cap. Patent 1666003. F. M. Crystler, 240 Hainbrook St., Belding, Mich.

TIRE BOOT—An internal blow out patch, which after being secured will remain affixed to the tire walls regardless of the heat and expansion of the tire. Patent 1666009. M. O. Haney, Iola, Kansas.

HEADLIGHT—Particularly adapted for use in connection with motor vehicles, for preventing "glaring" or upward reflections, the rays extending along parallel lines, without loss of light. Patent 1662322. B. E. Melton, c/o Morrison-Knudson Co., 1009 Continental Bank Bldg., Salt Lake City, Utah.

SHOE CLEANER—Especially adapted for automobiles, the scraper being spaced from the edge of the running board, while the bristles are arranged above, in a protected casing. Patent 1663972. C. Bruderlein, 9529 105 St., Woodhaven, L. I., N. Y.

WHEEL RIM—Of simple elements, adapted to be assembled on a wheel or demounted with ease, when assembled will possess strength and rigidity. Patent 1665092. T. L. Greewood, North East Harbor, Nova Scotia, Canada.

DIRECTION INDICATOR—Which is electrically controlled, and operated by hand, to indicate to persons approaching or following the automobile when a turn or stop is to be made. Patent 1663971. J. D. Brower, Jr., Box 8, Nill Valley, Calif.

TIRE CARRIER—Having a longitudinally extensible and contractile supporting arm, and reliable and conveniently operable means for adjusting the length, and positively locking the arm. Patent 1665647. E. A. Walters, 560 So. Hazelwood Ave., Youngstown, O.

DIRECTION SIGNAL—Positioned to display signals at opposite ends so that motorists or pedestrians from the front or rear will be appraised of the driver's intended movement. Patent 1664810. R. C. Forbell, 578 Matio St., Los Angeles, Calif.

DIRECTION SIGNAL—Movable at the side of the vehicle to indicate right or left turns, controlled by the steering wheel, and returned to normal after turning the corner. Patent 1663859. D. W. Pratt, 1904 Eleventh St., Santa Monica, Calif.

ATTACHMENT FOR BUMPERS—Which operates in the event of a collison to shield the bumper against direct contact, prevents marring the surface, and cushions the shock. Patent 1665780. H. Hamburger, 943 Main St., Santa Paula, Cal.

TILTABLE AND DIRIGIBLE HEADLIGHT—So constructed that the beam of light may be thrown downward, and manually operated from the steering gear, when approaching another vehicle, yet rigidly supported. Patent 1666856. T. C. Holliday, 309 Edwards Hotel Bldg., Jackson, Mississippi.

WHEEL TIGHTENER—Which affords facilities for using a relatively small force to exert a relatively great pressure, to firmly secure a portion of the wheel felly to the associated spoke. Patent 1666829. J. Olson, cor. 7th & "D" Sts., Lewiston, Idaho.

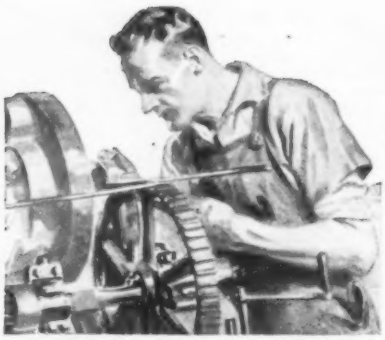
LOCK—Which may be readily applied to a conventional motor vehicle to engage and hold the control levers, to preclude the unauthorized use of the car. Patent 1666786. O. A. May, 319 W. Gold Ave., Albuquerque, N. M.

RADIATOR ORNAMENT—In the form of a miniature airplane, which rises and falls according to the air current induced by the movement of the vehicle. Patent 1666806. N. L. Wright, 47 So. 12th Ave., Mt. Vernon, N. Y.

PNEUMATIC-TIRE—Which may be readily applied to the wheels, and will give an audible warning when the pressure within the tire has decreased beyond a definite amount. Patent 1666155. L. H. Unglesby, Box 274, Baton Rouge, La.

AUTOMOBILE HEADLIGHT—A non-glare lamp, which uses two sources of light, each focused at different portions of the road, illuminating far in advance and relatively near. Patent 1666151. R. B. Stiert, Box 164, Kingman, Kansas.

SPRING STEEL TIRE—Which is free from blow outs, the steel portion lasting permanently, and the rubber tread being removable, permitting new treads to replace old ones. Patent 1666373. F. S. Feldheim, 1534 Wilder St., Evanston, Ill.



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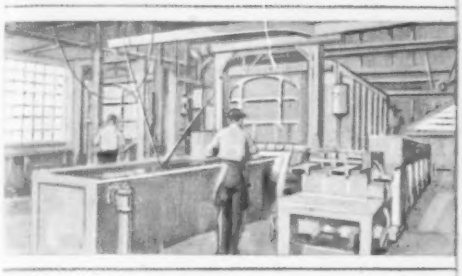
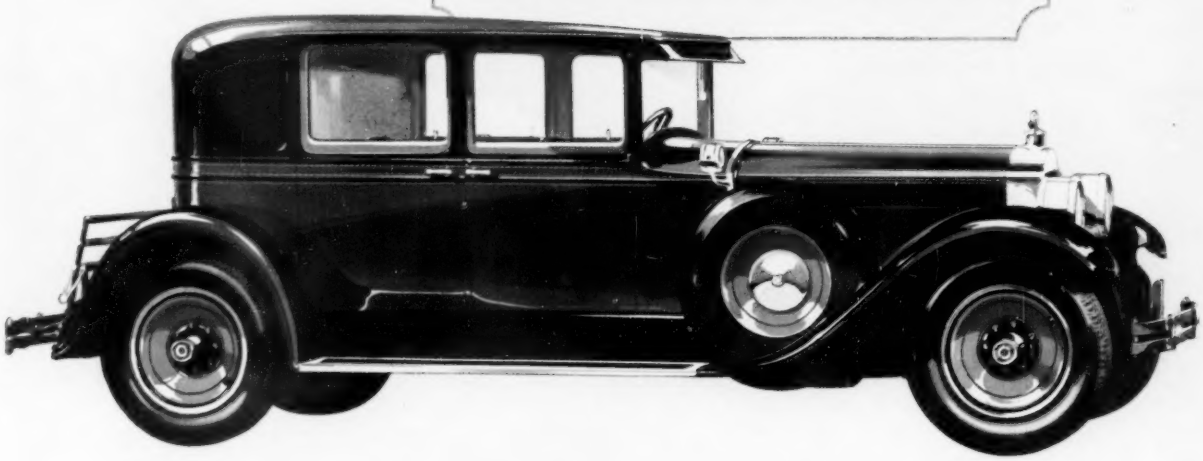


The methods used in heat treating metals in the early days of automobile manufacture were still those of the Dark Ages



PACKARD has made the heat treating of parts—annealing, tempering or hardening to fit them for their special functions—an exact and charted science.

Before Packard began its pioneering research, heat treating, as a process distinct from forging, was almost unknown. For centuries smiths had tempered steel while forging it—gauging heat by the color of the glowing metal and quenching their handiwork in a cooling bath of oil or water.

Today, the modern Packard furnaces are regulated by the most sensitive of pyrometers—quenching baths are prescribed by accurate and recorded formulas. Specific reactions and unvarying results are known in advance—the quality standards of Packard parts have been made certain.

The Packard car is a tribute to the metallurgical and manufacturing, as well as the engineering progress in which Packard has led. It has well earned its acknowledged leadership in quality, performance and long life.

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